# SCIENTIFIC AMERICAN

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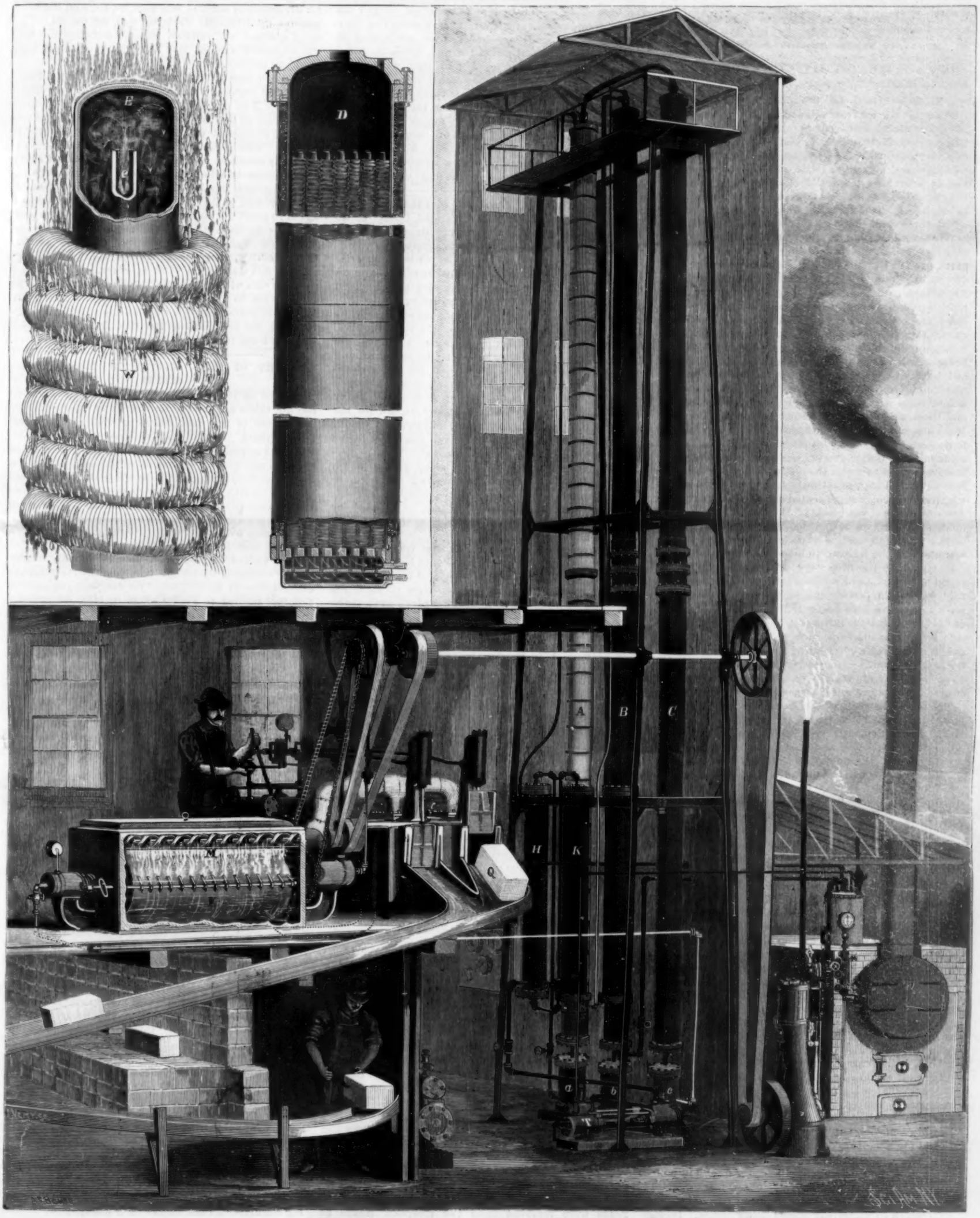
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXI.—No. 10. ESTABLISHED 1845. ] NEW YORK, SEPTEMBER 2, 1899. [$3.00 A YEAR. WEEKLY.


THE HOLDEN SYSTEM OF ICE MANUFACTURE.—[See page 151.]

# Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

*TERMS TO SUBSCRIBERS*

One copy, one year, for the United States, Canada, or Mexico ..... $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 3d. 4.00

*THE SCIENTIFIC AMERICAN PUBLICATIONS.*

Scientific American (Established 1845).....$3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878)..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, SEPTEMBER 2, 1899.


## NICKEL STEEL IN BOILER CONSTRUCTION.

The practical experiments which have been made in the use of nickel steel for boilers have so far given excellent results. Not only is there a lightening of weights due to the superior tensile strength of the alloy, but, what is more important, it has shown both under the test of actual service and in laboratory experiments that it is far more durable than the mild steel ordinarily employed. The saving of weight by the use of the stronger material is not, of course, of so much moment ashore as afloat; but the increased durability which may be given to boilers by using nickel steel for those parts, such as the tubes, which are subject to the most destructive influences, is a question of the very first importance to steam users. Whether the longer life of a boiler built partially or altogether of nickel steel more than offsets its greater first cost may be open to question, but present indications are that it does.

Among the most valuable data on the subject are those afforded by tests which have recently been carried out by Mr. A. F. Yarrow, whose experiments on the question of circulation in water-tube boilers, made a few years ago, attracted much favorable comment and threw upon the subject some greatly needed light. Mr. Yarrow states that the deterioration of boiler tubes is due chiefly to three causes: First, the action of acids in water due to grease; second, the oxidation of the overheated tubes on the outer surface through contact with the hot gases; third, the action of the steam, which if it become superheated decomposes and causes deterioration on the inside of the tubes. Mr. Yarrow made use of lengths of nickel steel and mild steel to ascertain the comparative resisting power of the two materials to the wasting influences above mentioned. This was done in three ways: First, samples were exposed to the action of a dilute solution of hydrochloric acid for certain periods and their weights before and after immersion were compared; then two tubes, one of mild steel and the other of nickel steel, were heated side by side in the same furnace, and the loss due to oxidation through overheating both on the inner and outer surfaces was carefully observed; and lastly, the tubes were heated externally and a jet of highly superheated steam was allowed to act on the inside.

The results in each of the three methods of testing showed the nickel steel to be far superior to the mild steel. In the first test, made on two specimens of the same weight, the loss after 533 hours immersion was in the case of the mild steel 53·19 per cent, while the nickel steel tube had lost only 3·72 per cent.

In the second lot of tests, the amount of oxidation due to the action of fire only was 2·9 times as great in the mild steel as in the nickel steel tubes.

In the third series, with fire outside and superheated steam inside, the nickel steel again demonstrated its wonderful powers of resistance. Each tube weighed originally 612 grammes, and after the test had been running for ten hours, the mild steel tube had burnt entirely through. At this point the nickel steel tube had lost 12·7 grammes as against 85·2 grammes lost by the mild steel. A second mild steel tube was put in, the nickel steel one being retained. After eight hours the second mild steel tube gave out. A third tube was tried and it had been running three hours before the original nickel steel tube gave out, after enduring the test continuously for twenty-one hours. The average life of the first two mild steel tubes was only nine hours. From the last series of tests Mr. Yarrow concludes that deterioration from this cause alone would make it necessary to retube a boiler carrying mild steel tubes 2⅓ times as often as it would one provided with nickel steel tubes.

Another important feature brought out in these investigations related to the permanent increase or decrease in length of boiler plates and tubes due to their heating and cooling. The frequent and sudden variations in temperature due to varying rates of combustion, to opening and closing fire doors, etc., it is well known, produce permanent changes of length in boiler material. In the present tests exact measurements were taken in order to secure accurate data on a question which so materially affects boiler design. It was found that in a mild steel tube 3½ feet in length, which was heated twenty-one times to a dull red for successive periods of two hours length each, superheated steam at a pressure of 60 pounds being passed through the tube, the permanent reduction of length at the close of the tests was seven-eighths of an inch. Now in the case of a nickel-steel tube of similar dimensions exposed to like conditions there was an increase of length of seven thirty-seconds of an inch instead of a contraction. The important bearing of this fact on boiler construction where nickel steel and mild steel are to be placed in juxtaposition is very evident.

Taken altogether, the results of these experiments form a valuable addition to the ascertained data on this subject, and they certainly point to nickel steel as the very material for boiler construction, judged on the score of durability; for Mr. Yarrow estimates that under working conditions boiler tubes containing 20 to 25 per cent of nickel will withstand corrosion for a far longer period than tubes of mild steel, while their resistance to destruction by the action of heated gases or steam is estimated as about twice as great. Of course it must be borne in mind that the greater cost of the alloy more than offsets its longer life, and for this reason mild steel will probably continue to be used for the ordinary stationary boiler; but for special work, where it is desirable to save weight and avoid frequent repairs, it is certainly the ideal material.

## TROLLEY CARS ON GRADES.

The trolley car disaster at Stratford, Conn., as we pointed out in our issue of August 19, directs attention not merely to the necessity for providing ample guard-rail protection on bridges but to the perils which arise from careless or ignorant manipulation of the cars on down grades. As a rule, electric cars are provided with unusually powerful hand-brakes and also with means to brake the car by reversing the current. The knowledge that he can stop the car in a very short distance is a temptation to the motorman to run at excessive speed on down grades and to swing around curves at a higher rate of speed than the super-elevation of the outer rail allows. This is a danger to which all trolley roads that combine steep grades and heavy curvature are exposed, and a proper regard for the safety of the public demands that an extra rail should be used on the inside of the inner rail where the degree of curvature exceeds a certain amount. This is particularly important on the long, steep grades which are to be found on many of the existing suburban or interurban trolley roads. A curve which a car will safely negotiate at a speed of fifteen miles an hour would derail a runaway car traveling at thirty or forty miles an hour.

Moreover, on all electric roads that traverse a hilly country the outer rail on curves should be elevated beyond the theoretical amount called for by the normal running speed of the car. This excess of elevation combined with the use of a steel guardrail against the inner rail on the curve would keep a car on the track at a high runaway speed.

The possible risks of a car "getting away" on a down grade received a curious illustration on August 21 upon the steep trestle which leads from the Jersey City Heights to the Hoboken ferry. It seems that the trolley pole had left the wire and that the motorman, in leaning out and looking back, lost his balance and fell from the car, leaving it free to descend by its own gravity. The track is thoroughly well guardrailed throughout, and no disaster followed. Fortunately among the frightened passengers was one having presence of mind enough to spring to the platform and apply the brake, thereby bringing the car to a standstill.

In view of the enormous growth of electric roads and the haste with which they are frequently constructed, it would certainly be advisable for the Legislatures to call in expert advice and pass some laws regulating the question of trolley car control and safety appliances, not merely on bridges, but on grades and heavy curvature.

## THE STATISTICS OF OUR VAST RAILROAD SYSTEM.

The latest report of the Interstate Commerce Commission shows that the vast railroad system of the United States has settled down to a steady rate of growth which is in marked contrast to the enormous and, as later developments proved, disastrous additions to its mileage which were made in the last decade. That a boom in construction which resulted in the addition during a single year of 12,000 miles of new road was altogether disproportionate to the demands of the situation was proved by the large number of roads which went into the hands of receivers during and after the panic of 1893. Of late years there has been a decided improvement in the railroad situation, for not only have many roads been removed from the control of receivers, but a certain amount of new construction has been undertaken. The report for the year ending June 30, 1898, shows at that date 94 roads operating 12,744 miles of track were in the hands of receivers, a decrease of 6,116 miles. During the year 45 roads were removed from the receivers' hands as against 11 roads for which receivers were appointed. The total number of railways in the United States was 2,047, and the total number of miles of track in operation, including side tracks and sidings, was 247,523.

To operate this system required 36,234 locomotives and 1,326,174 cars, an increase of 248 locomotives and 28,694 cars as compared with the previous year. The total number of passengers carried was 501,066,681, which is 11,621,483 more than in the previous year, while the number of tons of freight carried showed an increase of 137,300,361 tons, the total for the year being 879,006,307 tons. The gross earnings reached a total of $1,247,305,621, an increase during the year of $125,235,848, while the net earnings for the year were $429,352,345, an increase of $ 59,787,336. The amount available for dividends or surplus was $140,319,421, and the total amount of dividends declared was $96,240,864. The total amount of railway capital outstanding was $10,818,554,031, and of this only thirty-four per cent paid any dividend.

We learn that out of a total of 47,741 casualties there were 6,859 persons killed during the year and 40,882 injured. Two hundred and twenty-one passengers were killed, or one for every 2,267,270 carried, while the number of injured was 2,945, or one for every 170,141 carried. The perils of "railroading," however, are painfully manifest in the facts that one out of every 447 employés is killed and one out of every 28 is injured, the total number of killed during the year being 1,958, and of injured 31,761. We feel constrained again to point out that these statistics of injuries and fatalities indicate that much remains to be done in introducing safety appliances for the protection of employés. The Interstate Commerce Commission has done good work in enforcing the equipment of cars with automatic couplers; and it is to be hoped that in its leniency toward roads which are financially embarrassed it will not lose sight of the fact that the life and limb of the vast army of employés that work our railroads are of paramount importance.

## WEIGHT OF MAIL MATTER IN THE UNITED STATES.

Strange as it seems, the United States government has not taken a complete accounting of the actual total weights of the mail matter carried by it for over twenty years. During the time since the last general weighing of mails handled by the railroads and other common carriers the volume of our postal business has increased enormously, and in recent years the transportation weights charged for by these carriers have been largely taken on faith, as the Post Office Department could only estimate, but not accurately know, whether it was being overcharged in the enormous sums that it annually pays for mail transportation.

Some idea of the wonderful increase of this branch of governmental business is had from the fact that an expenditure of $30,393,209.53 for carrying the mails in 1888 had swelled to $52,294,382.23 in 1898, an increase to nearly double in ten years. In 1879 the total length of our postal routes was 79,991 miles; the last report shows it to be now 174,777. The annual transportation over these routes in 1879 was 96,497,463 miles, the last report showing a mileage of 281,595,613. In other words, less than twenty years has seen an increase of 116 per cent in the total miles of route, and of 191 per cent in the gross of annual mileage.

A partial idea of what this whole system of the transportation in bulk of our mail matter has grown to under enlightened management, and owing to the great increase in general literacy, is derived from the following statements taken from figures in the last annual report of the Postmaster-General: Of traveling post offices, on railway, steamboat, electric and cable tramways, we have 1,268 lines, covering 167,755 miles, with a grand total mileage of 285,565,343. Over these and throughout the service were handled 6,349,662,320 pieces of first-class matter, 5,876,043,900 pieces of inferior classification, and 591,492,490 pieces of purely city handling, a grand total of 12,817,198,710 pieces. These, if only averaging the length of a medium-sized envelope, would stretch 1,213,750 miles, or a little over forty-eight and one-half times around the earth.

It is scarcely to be wondered at, when we consider that an accurate weight tally of this enormous bulk of mail has not been taken within a time during which it has more than doubled in size, that there has been considerable Congressional and newspaper criticism of former Postmaster-Generals for paying the immense and rapidly growing bills for this transportation without question; nor is it to be wondered at that almost every session of Congress for the past decade has seen the introduction of some bill looking to the curtailment of these expenses.

The country is now to be congratulated on the fact that Postmaster-General Smith has set in motion an inquiry into this whole matter, from which will grow a clearer and more comprehensive report to Congress on this subject than has been possible since the days of the Grant administration. Three experts from New York city, aided by others already in Washington, have been for some days perfecting plans and preparing circulars, blanks, tables, etc., whereby on October 3 next every post office in the country will begin

weighing all matter passing through it. There are nearly 80,000 offices, and in each one of these this weighing will be kept up for thirty-five consecutive days. At the end of this time each office will forward to Washington its complete report and from this enormous mass of statistics will be compiled, by a special staff, yet to be selected, a wealth of information that cannot fail to benefit the service greatly.

It is likely that this general stock taking, if so it may be called, will reveal many opportunities for economy and kindred improvements in the railway postal service. It will assuredly set at rest the moot question as to whether bulk mail is being hauled back and forth, charged for both ways, by certain railways. It will also, we believe, show that both letter and newspaper postage, under proper restrictions, can be still further cheapened, and that manuscript designed for publication, proofs, and authors' revises and notes can all be treated more leniently in the interest of the wider dissemination of information and education by the press. The country is, also, to be congratulated that it now has at the head of this department a man of affairs, a newspaper man of long training, whose comprehension of the needs of the service under his charge is unusually broad and thorough.

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY HORACE C. HOVEY.

The forty-eighth annual meeting of the American Association for the Advancement of Science was held in Columbus, O., from August 19 to August 26, 1899, and was marked by many features of scientific and social interest. Preliminary arrangements were made with unusual care by a large and representative Local Committee, whose executive officers were Hon. Henry C. Taylor, Chairman, Prof. B. F. Thomas, Secretary, and Mr. F. L. Kiesewetter, Treasurer. Special committees on reception, finance, excursions, railroads, hotels, printing, etc., did everything well and contributed largely to the success of the meeting. The hotel headquarters were at the Chittenden, whose spacious and elegant rooms were admirably adapted for the occasion. Evening meetings were held in the auditorium of the Board of Trade building. The daily meetings were in the various and commodious buildings of the Ohio State University, accessible by street cars or carriages. A noon-day lunch provided at the Armory, and free to the guests, enabled them to spend the day on the grounds. The general session met regularly at 10 A. M., followed by sectional meetings, with a noon intermission, and closed at about 5 P. M. Placards placed conveniently on rocks or trees guided the scientists to the different buildings where the opening addresses were made by the sectional vice-presidents. After the first day, however, most of the meetings were held in Townsend Hall. Eight rooms were connected by telephone, and in each was a bulletin board whereon was indicated whatever was going on in the other seven rooms. All the telephone girls were students in the University and did their best to keep us apprised of the progress of affairs. Simple and practical as this plan appears, it has only been adopted once before, at a former meeting in Boston. The American Association for the Advancement of Science is created expressly for the diffusion of knowledge among the people, and is in no sense an exclusive society for the enjoyment or glory of a few favored ones. The ancient fiat "Let there be light" might well be its motto. Besides the regularly elected fellows and members, the privileges of the meetings were extended to their families and their hosts, and indeed to all who took enough interest in scientific research to induce attendance.

The retiring President, Prof. F. W. Putnam, called the association to order at its opening meeting, and introduced the newly chosen President, Dr. Edward Orton, who replied to the greetings of the State and municipal officials. Ably he set forth the aims and claims of the American Association for the Advancement of Science on public regard, showing that it represents the broad continent, already including the Canadian Dominion, and willing to include Cuba, Mexico and Central America on the same terms. An inventory of epoch-making discoveries and inventions previous to this century shows only fifteen items of the highest rank, for instance, the alphabet, Arabic numerals, the mariner's compass, the printing-press, the telescope and microscope, the barometer and thermometer, the calculus, gravitation, planetary motion, the circulation of the blood, the steam-engine, the foundation of modern chemistry and electrical science, and the measurement of the velocity of light. We might add certain medical discoveries, as those by Jenner. Something like this is the record prior to the year A. D. 1800. Counting on the same basis, Wallace finds no less than twenty-four first-class discoveries and inventions in the nineteenth century, as over against the fifteen or sixteen of all past time. These the speaker proceeded to enumerate and described as warranting our styling this as above all others the Age of Science. And it is for the further "advancement of science" that this association exists. Its very title indicates that its work is yet incomplete, and we still labor to discover new forms of truth and new arts for human welfare. His address was all the more impressive by reason of the discoveries that have made the name of Dr. Orton famous throughout America.

After the opening exercises the sections organized for business. The vice-presidential addresses were given Monday afternoon. The subject of Prof. Benjamin's address before the Section of Social and Economic Science was "The Past Presidents of the Association." Prof. Whiteaves, of Canada, spoke to the Section of Geology and Geography on "The Devonian in Canada." "The Fundamental Principles of Algebra" was Prof. Macfarlane's topic for the Section of Mathematics and Astronomy. The Section of Physics was addressed by Prof. Thomson on the "Field of Experimental Research." Prof. Storm Bull spoke before the Section of Mechanical Science and Engineering on "Engineering Education as a Preliminary Training for Scientific Research Work." The Zoologists heard Prof. Gage speak as to "The Importance and the Promise in the Study of the Domestic Animals." (An abstract of this address will be found in SCIENTIFIC AMERICAN SUPPLEMENT, No. 1235.) To Chemists Prof. Venable spoke on "The Definition of the Element." Botanists were told by Prof. Barnes as to "The Progress and Problems of Plant Physiology." The Section of Anthropology was addressed by Prof. Wilson on "The Beginnings of the Science of Prehistoric Anthropology." Most of these addresses may appear in the successive numbers of the SUPPLEMENT, and hence are only mentioned by title now.

Prof. F. W. Putnam, whose labors in every way, but especially as permanent Secretary of the American Association for the Advancement of Science, have so largely contributed to its success in former years, addressed a large and highly appreciative audience in the evening on "A Problem in American Anthropology." He introduced his remarks by an announcement of the recent death of the eminent anthropologist and Past-President of the Association, Dr. D. G. Brinton, and paid a glowing tribute to his merit and success. Yet Prof. Putnam differed from him on certain radical points, particularly as to his theory of an all-prevailing psychological influence guiding men's development, and his claim that American art and culture were autochthonous, foreign resemblances being but correspondential analogies. Prof. Putnam briefly reviewed the various theories held by other authorities as to American anthropology. In advancing his own views he said, in part, as follows:

"Some mounds cover large collections of human bones; others are monuments over graves of noted chiefs; others are in the form of effigies of animals and of man; and in the South mounds were in use in early historic times as the sites of ceremonial or important buildings. Thus, it will be seen that earth mounds, like shell mounds, were made by many people at various times."

He also said there was another class of earthworks that had to be considered by themselves, such as the Newark, Liberty, Highland, and Marietta groups. So far as these have been investigated they proved to be of very considerable antiquity, shown by the formation of over a foot of humus or vegetable matter upon their sides.

In studying the art of these builders, Prof. Putnam said we found the meaning only by turning to ancient Mexico. The famous Cincinnati tablet which has been under discussion for half a century can be interpreted by its dual serpent characters, understood by comparing it with the great double image known in Mexico as the Goddess of Death and the God of War. In speaking of the builders themselves, he said the fortified hills have their counterpart in Mexico.

Our Northern and Eastern tribes came in contact with this people when they pushed their way southward and westward, and many arts and customs were doubtless adopted by invaders, as shown by customs still among the Indian tribes. Prof. Putnam is of the opinion that man was on the American continent in quaternary times and possibly still earlier. Recent investigation has shown the occupation of the Delaware Valley during the closing centuries of the glacial period.

In speaking of the epoch of exploration, he said it was no longer considered sacrilegious to exhibit skulls and skeletons and mummies in connection with the works of ancient or modern people. He said the public need no longer be deceived by accounts of giants and wonderful discoveries, as there is too much authentic material now for comparison.

After the address, the members of the association returned to the Chittenden Hotel, where they were received by President and Mrs. Thompson, of the University.

## COPPER COINS MELTED UP.

Nearly ten thousand bags or about two hundred and fifty tons of copper coins have been brought from India. These coins are shipped as scrap copper and are worth more at the present price of copper than their coin value. The Brass Foundry Company, of New Haven, Conn., received five tons of this supply, and they have favored us with some interesting samples of the coins they are melting. The copper is worth 19 cents a pound in this country, but for 19 cents in American silver several pounds of copper coins can be obtained in Bombay or Calcutta. Of course, the coins are in common use there, but are so bulky that the natives are glad to dispose of them for silver and gold. The coins are bigger than a quarter of a dollar and are much thicker than any of our copper coins. They very much resemble the old American copper cent. There is no English inscription on the coins, and they are believed to be coined by the Indian native government in the early part of the present century, when the price of copper was very low.

## THE ALLEGHENY OBSERVATORY OBJECTIVE.

We have been favored by Mr. J. A. Brashear with some particulars regarding the new Allegheny Observatory, and the glass which he is to make for them. He says: "The old observatory, in which Profs. Langley and Kuhn did such good work, became unfitted for modern research. First, on account of its rather meager equipment, but what was far more important, the city has so encroached upon it that the atmosphere is usually vitiated by the smoke from houses, mills, etc. As chairman of the observatory committee, I first had the good fortune to secure a splendid site in the very center of the new park given to Allegheny City by its generous citizens, which is situated beyond the smoke environments. The place set apart for the observatory is a hill in the center of the park 552 feet above low water mark of the Ohio River and about 1,200 feet above sea level, and it is so situated with reference to the two cities of Pittsburg and Allegheny that the prevailing winds give us a practically clear atmosphere. It is a fact, however, that a small amount of smoke diffused through the atmosphere contributes to steady definition in solar work, to which, I think, we shall devote most of the time of the new observatory.

Plans for the new observatory are now nearly complete, Prof. F. L. O. Wadworth, the new director, having devoted many months to a careful and critical study of the detail of the building and instrumental equipment; and if the plans are carried out to the fullest extent we shall have an observatory for astro-physical research second to none in the world. Not the largest telescope, we are not after that, but a complete equipment for work in the domain of the new astronomy.

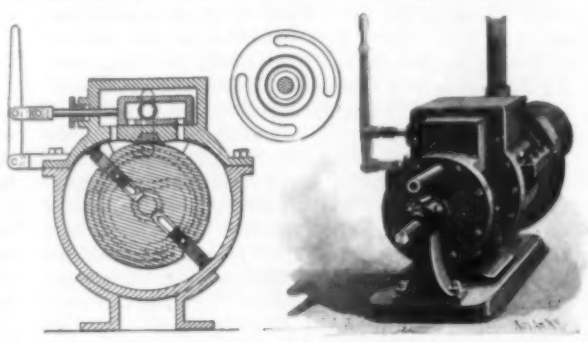
Our plans now are to have a 30-inch clear aperture telescope; the disks for the objective of which have already been ordered from Mantois, of Paris, and will be ready for us about the first of the year. A large reflecting telescope, perhaps of not less than a 36-inch aperture, will be constructed for spectroscopic work. A 13-inch refractor will be erected and equipped solely for the use of the citizens, or, in other words, a free observatory for the use of the higher classes in the public schools, and any and every one desiring to see the "beauties of the skies." This has always been a hobby with me, for well I know, when a boy, how I would have given all the little I had to have a look in a telescope. But I am getting off the track. In addition to the telescopic equipment we expect to have an immense siderostat, by which we can use the great objective for projecting the sun's image on the slit of the large spectroheliograph, which will, by this arrangement, not have to be carried by the eye end of the large telescope, but will remain stationary in a specially constructed underground apartment. The entire basement of the observatory will be fitted up for correlated research, i. e. especially in the domain of solar physics, and the beam of light from the great siderostat will be brought down to the basement and by suitable mirrors made available in every department of the observatory. The building will be provided with a 60-foot dome, a 30-foot and a 26-foot dome. The architectural design of Mr. T. E. Billquit has been accepted. It is classic in style, and will look very beautiful on the hill in the park. It will be visible over an area of perhaps 50 square miles.

Mrs. William Thaw, Jr., a lady of Allegheny, has given the money for the great objective as a memorial to her husband, who always had a great interest in the work of the observatory, having contributed to its success during his life time. The family of that staunch friend of the observatory, Mr. William Thaw, Sr., have provided for the great telescope. Mr. Andrew Carnegie has given $20,000 toward the project, and a number of Pittsburg's and Allegheny's best citizens have contributed handsomely to the fund for the new observatory. Mr. George Westinghouse has given the complete electric plant, and there is no doubt of the successful issue of this "Temple of the Skies."

I have devoted nearly all my time for nearly two years to raising the fund for the building and equipment, and as an old-time reader of the SCIENTIFIC AMERICAN, I am glad to give you these notes.

### AN IMPROVEMENT IN ROTARY ENGINES.

The accompanying engravings represent a perspective view and cross-section of a rotary engine, together with a cut-off valve employed therein. The inventors are James T. Hay and Gilbert L. Depuy, of Garland, Texas. The engine comprises a cylinder with a fixed abutment in its upper portion. The piston is mounted concentrically within the cylinder, and in contact with the abutment. In the piston, two piston-heads slide having blocks mounted to rock on their outer ends so as to accommodate themselves to the shape of the abutment. The piston-heads are pressed into contact with the cylinder by springs, resting on trunnion-bars engaging cam grooves in the head of the cylinder. Above the cylinder is a steam-chest connected with the cylinder by ports on opposite sides of the abutment. In the steam-chest, a sliding reversing-valve controlled by a lever is mounted. The valve is provided with ports adapted to register with the cylinder-ports, only one port of the valve being in register with the corresponding cylinder at a time. The registering ports serve as exhaust ports; while the cut-off port serves as a steam-inlet. One side of the slide valve opens at all times into an exhaust pipe, so that the exhausted steam can readily escape. Into the steam-chest a channel opens, registering at intervals with the segmental slots of a rotary cut-off valve secured to the main shaft and revolving in a casing of its own. The valve controls the opening of a steam supply pipe directly opposite the steam-chest channel. When a piston-head reaches a lowermost position, the steam is cut off, the corresponding slot in the cut-off valve being out of register with the steam-pipe. As the other piston-head passes the abutment and steam inlet, the other slot in the cut-off valve begins to register with the steam-supply pipe; and a second impulse is given to the piston. In order to prevent leakage of steam, the inner faces of the cylinder heads, the interior of the cut-off valve casing, and the cut-off valve, are formed with grooves adapted to receive the water of condensation. As the grooves fill with water, they form a packing for preventing the escape of steam.

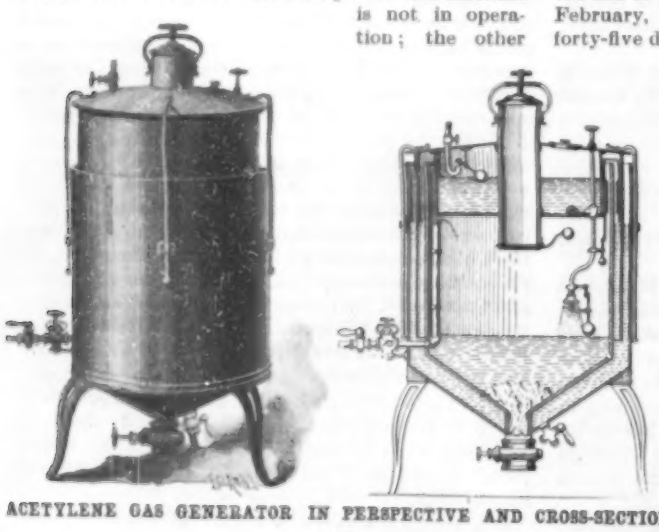


IMPROVED ROTARY ENGINE.

### A NEW ACETYLENE GAS GENERATOR.

We present herewith illustrations of a new acetylene gas generator, in which the production of gas is automatically regulated in accordance with the amount consumed by checking the water fed to the calcium carbide.

The apparatus comprises a generator surrounded by a jacket of water, a holder, the body portion of which occupies the space between the jacket and generator, a tank secured to the holder, and a carbide-receiver, which extends centrally through the holder and tank, and which is provided with a cover and with a weighted drop bottom. Into the tank extends a water-supply pipe which is controlled by a float-valve. A water-distributing pipe runs downwardly from the tank and is provided with a sprinkler which plays over the carbide and which is provided with a float-valve. The water-distributing pipe is provided with two valves. Of these valves, one is controlled by a stem projecting above the holder and is closed only when the machine is not in operation; the other valve is controlled by a weighted arm and opened and closed by the rise and fall of the holder.



ACETYLENE GAS GENERATOR IN PERSPECTIVE AND CROSS-SECTION.

In operation, calcium carbide is fed through the receiver, and water is turned on at the supply pipe so as to fill the tank to the height determined by the float-valve. The water from the tank will pass through the distributing-pipe and will be sprinkled over the carbide, thus generating gas which is conveyed to the burners by a service-pipe. When the pressure of gas becomes excessive, the weighted arm controlling the valve in the distributing-pipe closes the valve under the action of the rising holder and thus checks the water. When the pressure falls, the valve reopens automatically.

When the apparatus is to be cleaned, the lime is removed by opening a valve in the bottom of the generator. Water is then turned on at the supply-pipe and is automatically shut off by the float-valve of the sprinkler when the desired level has been reached. After a time the water is drawn off. The operation is repeated until the generator is clean.

Further information regarding this apparatus can be obtained from Frank Zunino, 230 Washington Street, New York city.

### Petroleum Joints for Common Iron Pipes.

A writer in Cassier's Magazine says that "To make a good petroleum joint with common iron pipes, a very good system is to heat both the male and female threads sufficiently to dissipate every trace of oil. Then make the joint up with thick shellac varnish, which may be combined with ordinary dry vermilion or even Venetian red. A joint of this kind I have found to stand well. A very good joint can also be made with ordinary yellow bar soap rubbed into the threads of the pipe, the grease first being removed. Treacle, honey, glue, mucilage, or glycerine, are quite petroleum-proof. For a stuffing box, ordinary wicking saturated with common yellow bar soap may be safely employed. Canvas, saturated with shellac varnish, makes a good washer, but soft metallic washers are better. A very good flexible diaphragm for a regulator may be made of closely woven cotton fabric, varnished on both sides with a compound of gelatine and glycerine. About equal parts by weight make a very tough and elastic compound. Wooden vessels, bags, etc., may also be made petroleum tight by saturating or varnishing with this compound. As a rule, all substances which are soluble in water are quite insoluble in petroleum. For stuffing boxes for standing both water and petroleum, castor oil may be employed, as this peculiar oil seems quite insoluble in either."

### Return of Mr. Wellman.

Walter Wellman and the survivors of his Polar expedition arrived at Tromsoe, Norway, a few days ago after successfully completing their explorations in Franz Josef Land. In the summer of 1898, an outpost was established in latitude 81°. Two Norwegians remained there while the main party wintered in a canvas covered hut called Harmsworth House at the southern end of Hall's Island, latitude 80°. In the middle of February, Mr. Wellman with three Norwegians and forty-five dogs started north. It is said to be the earliest sledge journey on record for that high latitude. On reaching Fort McKinley, Mr. Wellman found one of his Norwegians had been dead for two months and the survivor was safe and cheerful notwithstanding the fact that according to promise he had kept the body in the house. The party pushed northward through rough ice and storms until they found new lands north of Freedom Island where Nansen landed in 1895. About the middle of March disasters began. Mr. Wellman while leading the party fell into a crevasse, seriously injuring his foot. A number of the dogs were killed by the fall of blocks of ice and some of the sledges were destroyed. The condition of Mr. Wellman's foot became serious and the Norwegians dragged him on a sledge by forced marches nearly two hundred miles. Mr. Wellman is still seriously injured. The other members of the expedition explored regions hitherto unknown, and important scientific work was done. No trace of Andrée was found.

### The Color of Water.

BY PROF. SPRING.

The author reports on his experiments of many years to explain the color of the water. He has come to the conclusion that a pure blue is the natural color of water, for when we look through a long tube filled with distilled water against a brilliant white surface, a pure blue is seen, such as shown by the Lake of Geneva in quiet weather, a color which is not influenced by superficial or interior reflection.

When pure water becomes slightly turbid by extremely finely divided white or colorless particles floating therein, they reflect, even in the case of ground mountain crystal, a yellow light, which unites with the natural blue into a brilliant green color, such as is exhibited by the Neuenburg and Boden Lakes.

The peculiar facts established by various observers, that the water of ordinarily green lakes turns perfectly colorless at times, is not due to a clarification, but, on the contrary, to an influx of a reddish mud, colored by ferric oxide, which completely neutralizes the green.—Neueste Erfindungen und Erfahrungen.

### Wood Flour in Dynamite.

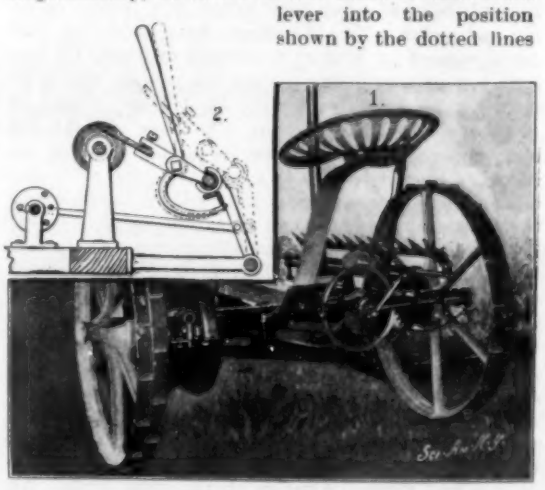
Wood flour is made by grinding saw-dust to a fine powder and is used for two general purposes: first, in the manufacture of dynamite and nitro-glycerine; and second, in the manufacture of linoleum and papyrolite, or artificial flooring. The wood flour is used as a cheap substitute for infusorial earth, which is the standard material for dynamite manufacture. It is regarded as distinctly inferior to infusorial earth for making explosives and it is only used where a cheap product is desired, or where the infusorial earth cannot be obtained. Wood flour has also been somewhat extensively used in the manufacture of linoleum. The floor-cloth is made by laying a coating of hardened linseed oil mixed with ground cork on a canvas net or back, but here again it was found to be hard and inelastic and for that purpose inferior to cork meal, so that its use has been abandoned by most German makers. Papyrolite is extensively used as a flooring for kitchens, halls, corridors, etc., and is also used on German war vessels because it has most of the advantages of wood, it does not splinter from shot or take fire. The subject has been investigated by several of our United States consuls, and the low price which is given abroad for it seems to offer little encouragement for imports from a source as remote as the United States.

### AN INGENIOUS MOWING-MACHINE-SICKLE GRINDER.

Our illustrations represent in perspective and cross-section a new form of grinder for mowing-machine-sickles, in which the grinding-disk merely rotates and the sickle is reciprocated by special devices.

The grinding-disk is arranged above the axle of the mowing-machine; its shaft is parallel to the tongue and is driven by gearing operated from one of the mowing-machine wheels. The sickle is mounted on a series of holders adjustably held in a slotted tube and adapted to be oscillated to and from the disk by means of swinging arms attached to a rod connecting them with an eccentric forming an attachment to the gearing already referred to.

The means for raising and adjusting the sickle to enable the grinding-disk to act successively on the cutters or knives, comprise a pivoted lever (Fig. 2) having a locking engagement with the swinging arms, which is maintained by gravity. When two cutters or knives have been ground and it is desired to shift the sickle longitudinally, the driver of the machine throws the lever into the position shown by the dotted lines in Fig. 2, thereby raising the holders and sickle. The same movement releases the lever from engagement with the swinging arms. The lever can now be used for moving the sickle longitudinally and lowering it upon the grinding-disk so that the next set of cutters can be sharpened. Hence, in bringing the new cutters into position, the lever is pushed laterally or away from the grinding-disk, and then parallel with the tongue of the machine.




MOWING-MACHINE WITH SICKLE-GRINDER APPLIED.

The arrangement of holders and co-operating devices, so that the sickle can be shifted parallel to the tongue, secures economy of space, safety, and ease of adjustment.

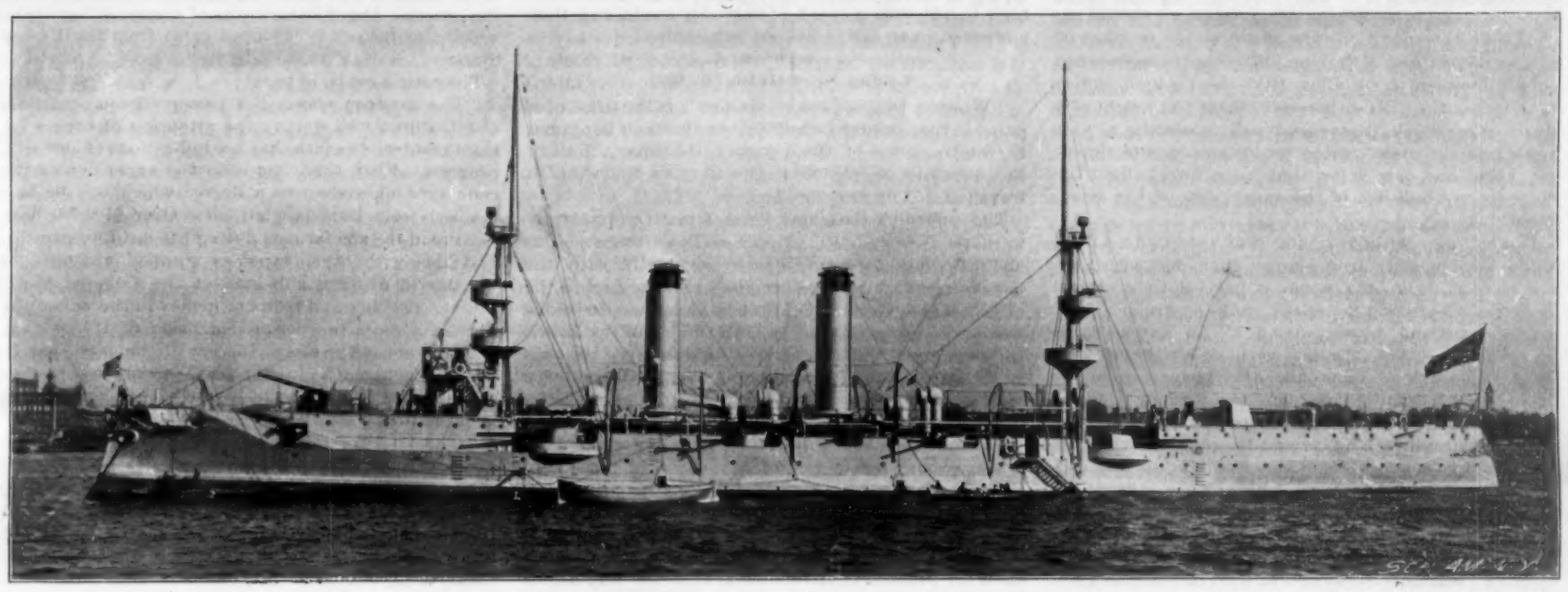
The inventor of this attachment is Eddie V. Green, of Topeka, Kan.

## PRESENT AND PROPOSED CRUISERS OF THE UNITED STATES NAVY COMPARED.

The recent war has imposed upon the United States responsibilities that are entirely novel and of far reaching consequence. The battle of Manila sounded the death knell of our policy of isolation, and the treaty of Paris so greatly extended the borders of our possessions that they may now be said to be conterminous with those of every nation that has a fighting ship afloat upon the high seas. Hence our navy has taken on a new meaning in the minds of the American people—it is no longer a mere adjunct of our coastline fortifications; it is our foremost line both for offense and defense. The countless islands of the Philippines scattered over a hundred leagues of sea call for ships that can steam both far and fast, ships which, when they have outstripped the enemy, can present a fighting line that is better able to give and take the hard knocks of a sea fight, and reasonably sure to fulfill to the letter the significant orders, "Sink or destroy."

In our issue of August 19, we gave some details regarding the plans of the proposed six new cruisers which were authorized by the last Congress, and showed that if these ships are built as designed they will be greatly inferior to ships of a similar size and type that are built or building for other navies of the world. Among the vessels selected for comparison was a United States ship, the "New Orleans." We are now enabled to present for comparison illustrations of both the new cruiser and the "New Orleans," and with a view to bringing out clearly the points of advantage possessed by one over the other we have compared the ships point by point in tabular form. We find that the full load displacement of the "New Orleans" is slightly over 3,500 tons, or practically the same as that of the new cruisers. This vessel is, therefore, an admirable foil to set off the good or bad points of the new design, for not only has she been tested in actual warfare, but, like the "Denver" class, she is sheathed and coppered and therefore suitable for a long stay in tropical waters without docking.

We find, then, that on every point but one the "New Orleans" shows a superiority, and on some points an overwhelming superiority, over the proposed cruisers; for she has 4½ knots more trial speed, she carries 100 tons more coal, has a 1¼-inch protective deck as against none, and has 3 inches of armor along the side slopes of the deck as against 2 inches for a third of the length; she carries 407 men as against 290; she has at present two torpedo tubes as against none, and her battery is heavier and more numerous. And yet the "New Orleans," though an ideal fighting machine, is not by any means a phenomenal boat; she merely represents modern ideas among the naval constructors of the world as to what elements should be combined in an up-to-date 3,500-ton sheathed and coppered cruiser.



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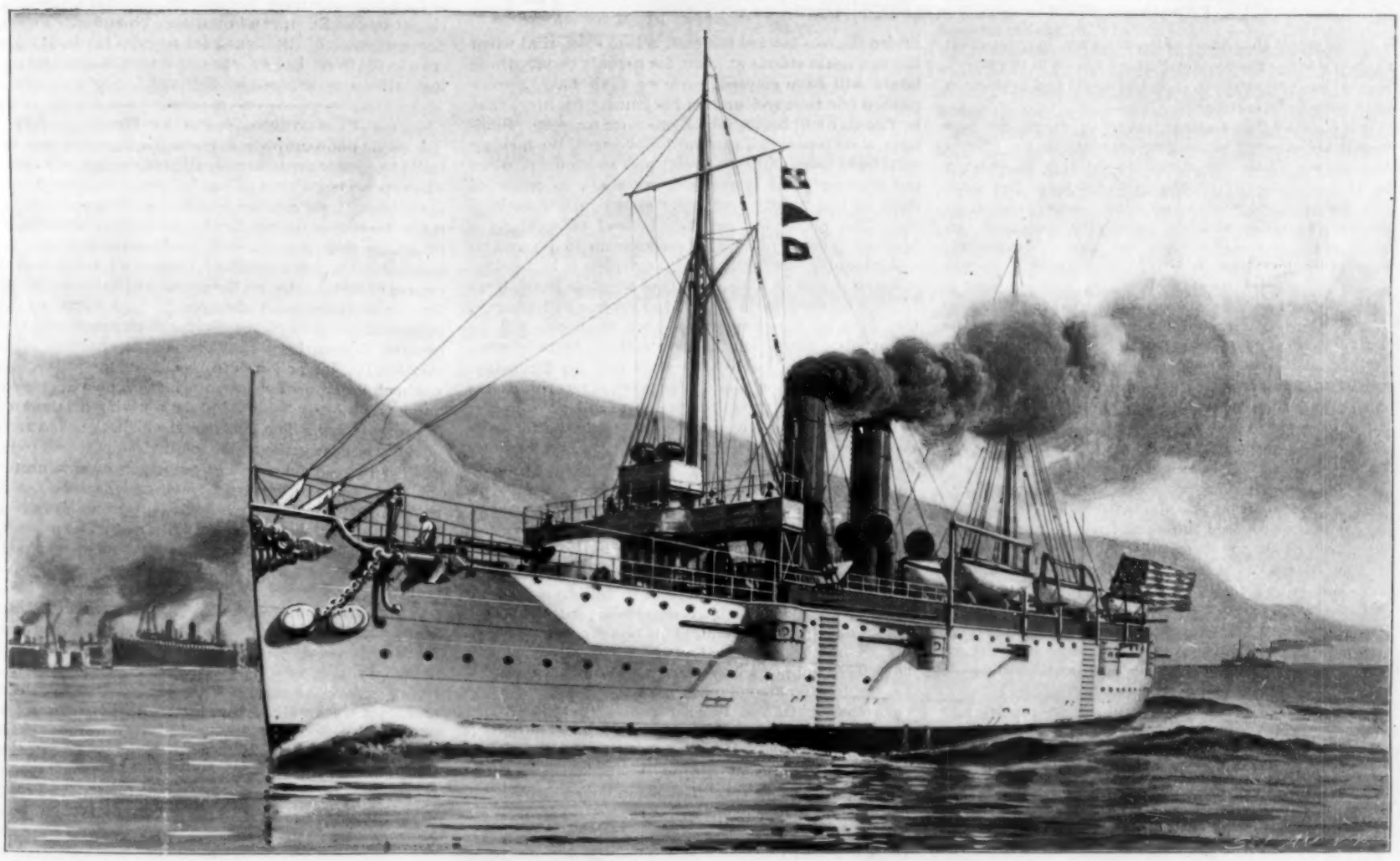
THE 3,500-TON PROTECTED CRUISER "NEW ORLEANS."

**Trial Speed,** 21·2 knots. **Coal Supply,** 800 tons. **Waterline Length,** 346 feet. **Beam,** 43 feet 9 inches. **Full-load Draught,** 20 feet. **Armor,** complete 1¼-inch protective deck from stem to ster: increased to 3 inches on the slopes. **Armament,** six 6-inch rapid-fire guns, four 4·7-inch rapid-fire guns, ten 6-pounders, four 1-pounders, four machine guns, two field pieces. **Torpedo Tubes,** 2. **Complement,** 407. **Date of Design,** 1896.

It will naturally be asked, What has been done with the 3,500 tons of displacement in the new designs? It is reasonable to suppose that with a speed less by from 3½ to 4½ knots (for the ships according to the contract may be accepted at a reduced price if the speed is less than 16½ but does not fall below 15½ knots), with 100 tons less coal, no protective deck, no torpedo tubes, and also with a saving in weight due to carrying 117 fewer men and their supplies—it is reasonable to suppose, we say, that some compensating advantages must appear in the new boats that are not seen in the "New Orleans." There is an undoubted advantage in the fact that the new ships are to have a flush upper deck, and will,



THE PROPOSED 3,500-TON SEMI-PROTECTED CRUISER "DENVER" AND CLASS.

**Trial Speed,*** 16½ knots. **Coal Supply,** 700 tons. **Waterline Length,** 292 feet. **Beam,** 44 feet. **Full-load Draught,** 17 feet. **Armor,** no protective deck, but a 2-inch strip on the slopes for 105 feet amidships. **Armament,** ten 5-inch rapid-fire guns, eight 6-pounders, two 1-pounders, four machine guns, one field gun. **Torpedo Tubes,** none. **Complement,** 290. **Date of Design,** 1899.

* The ships will be accepted at a reduced figure if the speed is not below 15½ knots.

therefore, be drier boats in heavy weather, and will provide more liberal breathing space for officers and crew. By comparing the illustration of the two boats it will be seen that the "New Orleans" has a forecastle deck, an open waist amidships, and a poop, whereas in the new ship the space between forecastle and poop is decked in, thereby affording an unbroken upper deck from stem to stern. This means the addition of considerable weight at a height of 16 or 18 feet above the waterline, and other things being equal, we should expect that this addition was made at the sacrifice of some other features of the ship. But other things are not equal; for even if we allow that the 1¼-inch protective deck of the "New Orleans" offsets the weight of a flush upper deck, that vessel still possesses a vast superiority in speed, better protection on the slopes, more coal, and over 30 per cent more men to fight the ship; to say nothing of the superiority of her armament.

While it goes without saying that a ship with a flush upper deck is drier in a seaway than one with forecastle, open waist, and poop, it has yet to be proved that it is wise to sacrifice speed, coal and armor merely to prevent a ship from throwing a little water aboard in squally weather. Unless we have altogether misread the lessons of American naval history, unless we have quite failed to appreciate the fighting spirit of Paul Jones, Decatur and Farragut, we think that the typical American seaman would be quite willing to receive an occasional swish of salt water in his eyes or a roll of green seas across his deck for the sake of an extra gun or two in his battery, or 3 or 4 knots extra speed on tap in the engine room at the critical moment. During the operations of the late war, the "New Orleans" was able to respond at any moment to a call from the Admiral for a 19-knot sea speed, and her varied experience in the twelve months of her service has never seen a time when she could not "cast loose" her guns for action. Seaworthiness is of course a prime factor in a warship, but in this, as in all other matters, it is possible to go to extremes. England has done so, with the result that many of her ships are, in proportion to their size, the most under-gunned vessels in the world. In our six new cruisers, it is the speed and protection that have been sacrificed.

| | Full Load Displacement, Tons. | Speed, Knots. | Coal Supply, Tons. | Protective Deck. | Armor on Slopes of Deck. | Crew, Officers and Men. | Torpedo Tubes. | Main Battery. | Secondary Battery. | Waterline Length. | Beam. | Draught, Full Load. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Orleans | 3300 | *20 | 800 | 1¼-in | 3-in. | 407 | †3 | six 6-in. r. f., four 4·7-in. r. f. | ten 6-pdrs. four 1-pdrs. four mch. guns. two field guns. | 346 ft. | 43 ft. 9 in. | 20 ft. |
| Denver Class | 3500 | ‡16½ | 700 | none. | 2-in. for 105 ft. | 290 | none. | ten 5-in. r. f. | eight 6-pdrs. two 1-pdrs. four mch. guns. one field gun. | 290 ft. | 44 ft. | 17 ft. |

* The speed of the New Orleans on trial was 21·2 knots. † One of these has been removed.
‡ If the speed on trial is as low as 15½ knots, the ships will be accepted at a reduced price.

It is claimed that another feature in which the new vessels are superior is the accommodations for officers and crew. These are stated to be very superior, a point that may well be conceded, for upon the same displacement and with hundreds of tons saved upon engine and boiler weights, protective deck and torpedo outfit, she carries only 290 men as against 407 carried by the "New Orleans." Here again it looks as though a principle good in itself, and when applied in moderation, had been pushed altogether too far. Inquiry of both officers and men who have served on the "New Orleans" failed to elicit any serious complaints of inconvenience due to overcrowding. Give to the typical American sailor a reasonable amount of living space, and then offer him his choice between more guns, more speed and better protection, or a few cubic feet additional space in his living quarters, and he will take the ship with the better fighting qualities in every case.

It is evident from the shallow draught and short length of the proposed ships that their slow speed must be due in part to their fuller lines. Although the "New Orleans" is 54 feet longer, of 3 feet more draught and the same beam, her displacement is about the same. Hence it is certain that her lines must be very much finer and undoubtedly the 4½ knots extra speed is partly due to this. Again, her large horse power (7,500 as against 4,500 for the new boats) is obtained without a proportionate increase in weights, by using a high speed of revolution in the engines; a principle that has been adopted with success in other ships by the same designer. Other economies in weight are due to the fact that from stem to stern there is nothing in the ship of the purely ornamental or fanciful; the broad principle of utility has been followed to its ultimate limit, and in this respect the "New Orleans" is more like an American production than the product of a European yard.

The effort of the department to secure ships of exceptional seaworthiness and liberal berthing accommodation is highly commendable; but we think it is evident from what we have said that the sacrifices in speed and protection are out of all proportion to the benefits secured. It would have been better to have taken the "New Orleans" as a basis and given her a flush deck and improved freeboard at the cost of an additional two or three hundred tons of displacement rather than to have gained roominess and comfort by building half-protected cruisers, which, by the very terms of the contract, may be thrown upon the country's hands with a speed of only 15½ knots, and this, moreover, in an age of 20-knot battleships!

### Losing or Gaining a Day.

"Where a Day is Lost or Gained" is the title of a paper in the Century for September, in which Benjamin E. Smith, editor of the Century Dictionary, tells of the difficulty of reckoning the days of the week in traveling east or westward.

The difficulty that may lie in a matter apparently so simple is well shown in one of Poe's stories. The obdurate father of the maiden—evidently with the Greek calends in mind—promises to give her to the objectionable swain when three Sundays occur in one week. To his consternation, and the joy of the lovers, this seemingly impossible event indubitably happens when two sea-captains appear together upon the scene who have circumnavigated the globe in opposite directions.

As a matter of fact, this bit of fiction represents what is taking place every day in the year, and must continue to occur as long as our present method of reckoning time is retained. And the reason for this is simple and familiar. The civil day begins and ends at midnight, but for convenience of explanation let us assume (as is the practice of astronomers) that the day begins at noon and ends at the following noon. It is clear that the interval of time between two successive noons will be, for us, twenty-four hours (a day as measured by one complete rotation of the earth) only when we remain on the same meridian. For, if at noon on the beginning of Monday we move, say, over a space of fifteen degrees toward the east, it is obvious that when the sun again stands at noon, for us, only twenty-three hours will have elapsed, since we shall have accomplished one twenty-fourth of his journey for him; that is, Tuesday will begin, for us, one hour too soon. Similarly, if we repeat this eastward movement, Wednesday will begin two hours too soon; and so on until, when our starting point is reached, we shall, in count of days, be just twenty-four hours ahead in our reckoning. The result will be that, instead of ending the journey in twenty-four days (as we seem to do) and on a Wednesday, we shall actually complete it in twenty-three days and on Tuesday. On the other hand, if we move westward in this way, the reverse will happen. Our days, as measured from noon to noon, will be twenty-five hours long, and we shall actually complete the trip in twenty-five days and on Thursday. For the stay-at-home, and for travelers returning thus from the east and from the west, there will, accordingly, if no correction is made in the reckoning, be for each day three distinct dates, each perfectly corrected by diary or log; and each day of the week—not Sunday simply—will be repeated thrice.

### A New Remedy for the Phylloxera.

The Italian Minister of Agriculture and several scientists of that country are engaged in testing a medium which is to protect the Italian vineyards from the ravages of the phylloxera. This remedy was first employed by the vintager Lauro d'Angelo on Elba. It consists of copper sulphate and its application is exceedingly simple and cheap. According to the Naturwissenschaftliche Wochenschrift, the plants are sprinkled with dissolved copper sulphate and some is thrown on the ground in a powdered state. By the rains in fall, winter and spring, the powder is dissolved and enters the soil. The method employed by d'Angelo consists in giving the vines first two liquid treatments, followed by five with the powder. In the former case there are used 1 per cent of lime and 1·8 per cent of copper sulphate per 100 kilos of sulphur; in the second case the vine plants receive two treatments with 2 per cent of copper sulphate and three with 5 per cent to every 100 kilos of sulphur.

### Sugar Industry in Trinidad.

Minister Loomis sends from Caracas, under date of June 14, 1899, a clipping from the Port of Spain Gazette, setting forth the condition and prospects of the sugar industry in the island. Trinidad, says Mr. Loomis, is one of the most successfully governed and prosperous of the British possessions in the West Indies and is a model colony. The largest cane factory in the West Indies is the Usine St. Madeleine, referred to in the article. About nine-tenths of the machinery with which the factory is equipped came from the United States.

The article reads, in part:

"The last crop season has presented some remarkable features, well worthy the attention of others besides planters, because they are indications of material progress. First, there has been the expansion of the cane farming system to a degree which will be best realized from its financial side. Over $100,000 have been paid to cane farmers during the last four months, and this, with other expenses entailed, accounts for the dearth of notes and gold at the Colonial Bank. . . . The flux and reflux of money in the colony indicates a more prosperous condition of things than was previously the case. In view of the fact that no abnormal change had taken place in the cocoa production, it must be due to the improved prospects of the sugar industry.

"The study of this material change for the better presents some interesting features. We first perceive that this year's sugar crop is a large one, exceeding the average of 56,000 tons. Nearly one-fourth of the crop has been made by the Usine St. Madeleine, whose output to the closing day this week is 13,000 tons—an increase of 1,500 tons over the output of last year. This Usine is the premier central factory in the West Indies since the war in Cuba, where previously the Constancia factory and two others exceeded the output of the local Usine. A characteristic of the crop operations has been not only that farmers' canes have been plentifully bought by the factories, but that one or two estates which were threatened with abandonment have continued to exist by also selling their canes to the factories. . . .

"Another notable feature of the sugar crop this year was the effect of the American countervailing duties in putting new life into the local and Demerara sugar industry. The same result has been reported in the case of Mauritius in consequence of the imposition of the Indian countervailing duties. The planters of that island are now shipping sugar at remunerative prices to India. And yet there has been no great rise in the price of sugar to startle the American or Indian consumer; but a fair market has had its inevitable result for an industry enabled in the nature of things to hold its own, and only prevented from doing so for some years past because of markets artificially rigged by the European bounties. This affords a clear demonstration of the beneficial results that would accrue to the West Indian sugar industry if countervailing duties were imposed by England."

### Photographs Taken by Magic.

A magic photograph is a photograph which can be made to appear on an apparently blank piece of paper. The process of making it is as follows: Make a photographic print on a piece of albumen paper, printing it the exact tone desired in the finished print. Wash for two or three minutes and place, without toning, in the fixing bath, composed of 1 ounce of hypo and 8 ounces of water. Leave the print in the fixing bath for five minutes, wash thoroughly, then place it in a saturated solution of bichloride of mercury until the picture has entirely disappeared. Leave it in this solution just long enough to bleach out the print, then wash and dry as for other prints. The paper now appears perfectly white, but it contains a latent or invisible image. The magic by which the picture is made to appear is the action of hyposulphite of soda. Soak a piece of clean blotting paper in a saturated solution of hyposulphite of soda, and dry. When it is desired to make the picture appear, moisten the blotting paper slightly, and place the picture on it face down, rubbing it to insure perfect contact. In a minute or two the picture will begin to appear, and will soon be as bright and clear as when first printed. When one wishes to show this magic photograph, it is more surprising to the uninitiated if the blotting paper has been moistened and placed in a book. Show the apparently blank piece of paper, slip it in the book, and in a minute or two take it out, and what was to all appearance a piece of plain white paper will be found to have a picture printed on it. The picture will disappear after being exposed to the light for some time, but it can be made to reappear indefinitely. It will be found that much interest is taken in the process, and the production will afford much astonishment.—Hobbies.

THE Tripler Air Power Company is to be reorganized, and it is said that Mr. Tripler has discovered a process by which liquid air can be safely and economically furnished for refrigerating purposes.

### ICE MANUFACTURE ON A NEW SYSTEM.

By the courtesy of Mr. D. L. Holden, who has been connected with the manufacture of artificial ice for over thirty years, and, by virtue of his early improvements, may justly be called the father of that industry in America, we were recently given an opportunity to inspect the remarkably interesting plant which is illustrated in the first page of this issue. Those of our readers who are acquainted with the systems commonly in use will see that, in introducing an entirely new method for making ice on a commercial scale, an important reduction has been made, both in the magnitude and first cost of the plant and in the cost of manufacture. Under the present methods, known as the "can" system, a plant capable of producing 100 tons of ice in twenty-four hours requires a house 100 feet by 150 feet square, and working under the best conditions the product costs from $1.65 to $1.85 per ton. A plant of equal capacity working on the new system will call for a house 25 feet by 50 feet, and the ice can be produced at 50 cents a ton, which is the actual cost per ton of operating the plant which forms the subject of this article.

The Ammonia System.—This is a combination of the compression and absorption systems, in which the inefficiencies and losses of both are reduced to a low point or removed altogether. It consists, in the plant in question, of three vertical pipes, 12 inches in diameter and 40 feet in height:—the still, *A*; the absorber, *B*; the condenser, *C*; two shorter pipes:—the interchanger, *H*; and the cooler, *K*, and the ammonia pump.

The still is a steam-jacketed wrought-iron pipe, 12 inches in diameter, whose interior is filled with about thirty-six 1-inch closed steam pipes, which are connected to the manifold at the base of the main pipe, and extend to within a few inches of the top (see Fig. *D*). Each steam pipe, *E*, is wound from top to bottom with a spiral coil of wire, *w*. The steam is introduced at the top of each 1-inch pipe by an internal ¼-inch pipe, *c*, which extends the full height of the pipe, as shown in the illustration. The Absorber is identical to the still in its construction, the pipes, *E*, being, however, in this case filled with circulating water in place of steam. The Condenser is also filled with a nest of vertical water pipes, but the encircling coils of wire are absent. At the bottom of *A*, *B*, and *C* are three short lengths of pipe, *a*, *b*, *c*, called Receivers, which serve to collect the liquid contents from the larger members above them. The Interchanger, *H*, and Cooler, *K*, are simply vertical 12 inch pipes containing coils through which the "weak liquor," or aqua ammonia of 16° to 18° B., circulates and is cooled.

We will now describe the continuous process by which the "strong liquor," or aqua ammonia of 32° B., is converted to pure anhydrous ammonia, ready for evaporation in the ice machine proper. The strong liquor is introduced at the top of the Still and allowed to drip over the wire coils and the pipes which they surround. Here it is broken up into myriad particles and the area of the liquid exposed to the heat is enormously increased. The wire coils, moreover, being in close contact with the steam pipes, are heated and serve to greatly increase the total heating surface. The ammonia gas separates freely from the liquor, as the latter trickles through the heated wire coils, and it passes off by a pipe from the top of the Still to the top of the Condenser, *C*. Here it is condensed upon the surface of vertical water pipes, similar to those in the Still, condensation taking place under its own pressure at the temperature of the cooling water. By this arrangement the distillation of the ammonia proceeds automatically and with great regularity; there is, moreover, a total absence of priming and practically no evaporation of the water; as is evident from the fact that the anhydrous ammonia which collects in the Receiver, *c*, below the Condenser is over 99 per cent pure. From this Receiver the liquid ammonia is conducted by a small pipe to the Freezing Cylinder, within which, as will be explained later, it serves by its evaporation to produce a layer of ice on the outer surface of the cylinder. The ammonia gas is then led out of the Cylinder through the opposite trunnion and conducted by a pipe to the top of the Absorber.

Returning now to the operation of the still, the hot, weak liquor, whose strength, as the result of the distillation, has been reduced to from 16° to 18° B., collects in the receiver, *a*. From this point it is forced under a pressure of 150 pounds to the square inch through a coil within the Interchanger, *H*, where it gives up its heat to the hot, strong liquor which is being pumped through the Interchanger on its way to the top of the Still. From the Interchanger the weak liquor passes through the Cooler, *K*, and thence to the top of the Absorber, *B*, where it meets the ammonia gas, which is being led direct to this point after having done its work in the Freezing Cylinder, *F*. The weak liquor is broken up on the wire coils, in the same way as the strong liquor in the still, and just as there these wires presented a large surface for distillation, so here they present an equally favorable condition for absorption, and by the time the liquor reaches the Receiver, *b*, it has absorbed the full amount of gas that it can hold under the pressure and temperature existing within the Absorber. The liquor, which now has a strength of 32° B., is then forced by the compression pump, *T*, through the Interchanger, *H*, where it absorbs the heat of the hot, weak liquor, which, as we have seen, is passing through the interchanger coil, and then it passes to the top of the Still to be again distilled and pass through the cycle of operations as above described.

From what has been said it will be seen that the troublesome back pressure, or accumulation of gas in the expansion or freezing cylinder, or in the expansion coils of other systems, is prevented, and it is possible to secure the proper fall of temperature due to a full expansion of the gas. On the occasion of our visit to the plant the back pressure, as registered at the pressure gage, was only 6 pounds per square inch.

The Manufacture of the Ice.—It is in the method of making the ice, however, that the greatest departure is made from existing methods as practiced in what is known as the "can" system. The ice machine, which in the plant under consideration has a capacity of 10 tons a day, consists of a tank of water 3¼ feet in depth by 3½ feet in width and 7 feet long, within which rotates a hollow cylinder, *F*, which is journaled in the end walls of the tank by means of trunnions, upon which it rotates. The anhydrous ammonia is led into the cylinder through one of the trunnions in a sufficient quantity to keep the bottom of the cylinder filled to a depth of 2 or 3 inches. Since the cylinder is constantly rotating, the whole interior is kept constantly wet with a thin film of ammonia which rapidly evaporates; and as the boiling point of liquid ammonia is —32° F., it follows that there is a difference of 64° between the boiling ammonia and the water which is in immediate contact with the outside of the cylinder. Hence the water freezes to the cylinder with great rapidity, and would incrust it at the rate of a quarter of an inch per minute if provision were not made to remove it. As fast as it forms, however, it is cut away by means of a set of knives arranged on a shaft, which latter is oscillated by means of a yoke on the outside of the tank fed with a worm gear from the trunnions. The knives turn off the ice-crust as fast as it is formed, keeping it down to a thickness of about one sixty-fourth of an inch. The ice shavings or "spawls" rise to the surface of the water and collect within a hood which extends longitudinally across the top of the tank, where they are caught and carried out of the tank by the screw conveyor, *M*, and forced into a pipe which leads to the two hydraulic presses shown in the engraving. The ice scrapings or spawls carry with them a considerable amount of water, and the mixture has something of the appearance and consistency of ice slush. The pipe by which the spawls are carried off has a three-way valve, by means of which the constant stream of material may, as soon as one press is filled, be turned into the adjoining press. The sides of the presses are formed with channel ways and are lined with perforated brass, and under the working pressure of 325 pounds to the square inch the water and air are squeezed out through the perforations, and regelation sets in throughout the whole mass. The end door of the press is then opened, and there issues a block of compact ice which is absolutely free from air bubbles and is capable of cleavage in any desired direction. By the time a block has been compressed in one press the other press has been filled with spawls. The process of compression and regelation is, therefore, continuous, and in one and one-half hours from the time of starting, the plant is capable of turning out ice at the rate of 10 tons per day.

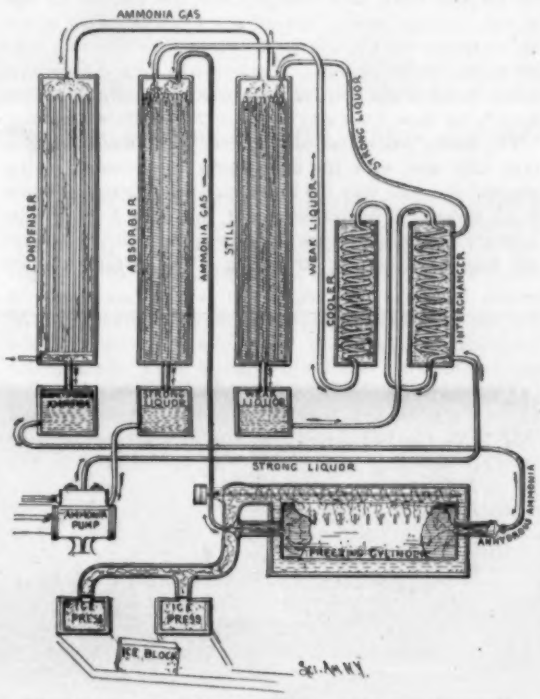



DIAGRAM OF THE AMMONIA AND ICE-MAKING PLANT.

The advantages and economies of this system over the "can" system are many and obvious. In the first place the absorption of heat from the water takes place through the thin iron wall of the cylinder, whereas in the "can" system the absorption must take place not only through the sides of the can, but through the ever increasing wall of ice that forms within the can. The resistance of ice to the transfer of the heat of the water increases as the square of the thickness of the ice, and it is for this reason that the interior core of an ice block is so slow in freezing. In the cylinder process, on the other hand, the ice is never more than a sixty-fourth of an inch in thickness and the transfer of heat is immediate. Again, in the "can" system the ammonia is expanded in coils of pipe laid in a tank of circulating salt water, which contains the cans of water to be frozen. The whole contents of the tank must be reduced to freezing temperature before the contents of the can begin to freeze, and hence it is that it takes three days to set a "can" plant in motion, when one and a half hours suffices to start the smaller, simpler, and more direct system which we have described in this article.

We have already referred to the great economy in space effected by the combined system. This is well illustrated by the fact that while the freezing tank of a 10-ton plant under the present system has a capacity of only 85 cubic feet, a freezing tank of equal capacity under the "can" system would have a capacity of 1,800 cubic feet. It is this remarkable compactness that renders the combined system so valuable in cities, where, on the one hand, the high cost of land drives the ice plant to the outskirts, and on the other hand the question of meltage necessitates the plants being erected within a comparatively short hauling distance of the consumer. Another feature which will be welcomed by consumers of ice on a large scale, such as large hotels and packing establishments, is that the reasonable space required for the plant will enable them to become their own producers.

### Firemen Killed by a Live Wire.

We have been favored by two correspondents with information and with Omaha papers containing an account of an extraordinary accident which recently occurred in that city.

On August 9, four firemen were killed and two painfully injured by an electric shock from a live wire while working at a fire. They were engaged in withdrawing an iron-bound ladder from a rear wall when the upper extension came in contact with one of the parallel wires in an alleyway. All the men had their hands on the cranks of the windlass and the current ran down the ladder, entered their bodies and threw them to the ground. The fire was extinguished and the ladder was being lowered when it came in contact with a bare spot in a number six wire that carried a 2,000 volt alternating current. The truck was so arranged that there were six cranks on winches to be used in lowering the water tower or ladder. One of our informants calls it a water tower and the other a ladder. When the ladder or tower struck the bare wire, the current followed the tower to the ground through the six men's bodies. Two of the men handling two of the wheels were pulled loose by bystanders, one of whom was knocked senseless. These two were very severely shocked, but four of the men were not loosened for several seconds, and when they were they fell writhing to the ground. One of them rose and walked two hundred feet, saying he felt all right, and then dropped dead. A heroic struggle was made to restore the men to life.

Accidents of this kind are most unfortunate, and cannot, we suppose, always be avoided, but whenever possible, underground conduits will do away with much trouble of this kind.

### Russian Caravan Tea.

A large part of the tea which comes from China into Europe is brought across the steppes of Siberia by caravans of sledges, which have for their destination one of the eastern towns of Russia. Although the caravans require at least a year to cross the vast extent of Siberia, this method of importation is the most economical, on account of the very heavy duty which is laid upon tea brought into any of the Russian sea ports. These caravans are usually made up of fifty to seventy sledges, and sometimes a caravan is seen which contains two or even three hundred. Each of the sledges carries on an average five bales of tea, packed in cow's skin and weighing from fifty to eighty kilogrammes each. The sleds are drawn by a single horse and are united in groups of five or six under one driver. Each sled carries in the rear a bundle of hay and a quantity of oats, which serves as a supply for the horse of the sled following. To provide for the first horse, the order of the sledges is changed from time to time. The caravans make halts of three or four hours in the villages, to give the drivers time to take care of the horses and to eat, but the drivers sleep only on the sledges, en route, in spite of the fact that the temperature in these regions falls as low as —60° C. The caravans finally reach the eastern part of Russia, from whence their cargoes are sent to Moscow, St. Petersburg, and other large centers of distribution.

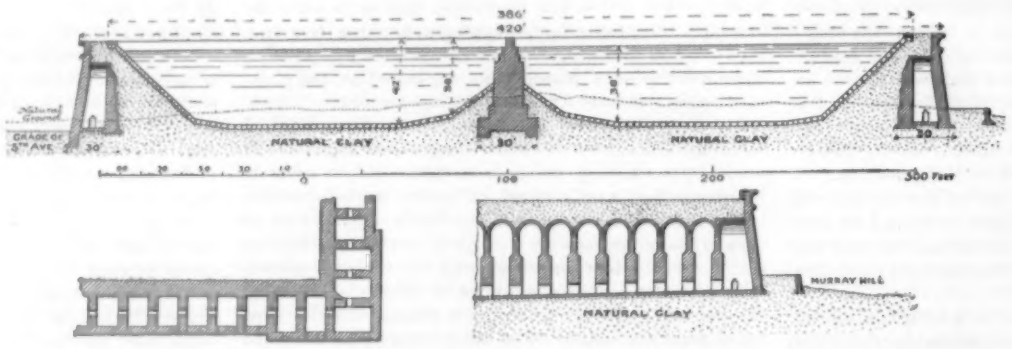
## REMOVAL OF A FAMOUS ENGINEERING LANDMARK.

There is now in course of removal one of the most famous engineering landmarks in New York city. The Murray Hill, or Forty-second Street, Reservoir, as it is more popularly known, was erected as part of an elaborate scheme of water supply which was inaugurated and successfully carried through some fifty years ago. At that time the population of New York was about 350,000 souls, and as the existing means of water supply was growing inadequate, it was resolved to build a system which should anticipate the future growth of the city and meet its ever-enlarging needs for many a decade to come. Accordingly, the engineers went some forty miles up the Hudson River, and turning eastward up the valley of the Croton River, selected the Croton watershed as the future source of water supply for the metropolis. At a point about six miles from the Hudson they threw across the valley the Croton Dam, thereby creating a reservoir with a capacity of 1,000,000,000 gallons. From the dam the water was led by the famous "old aqueduct," which when running full has a capacity of 90,000,000 gallons per day, and when filled to its ordinary level carries about 75,000,000 gallons. Upon the high land at Central Park a storage reservoir of 200,000,000 gallons capacity was constructed, and from this the water was led by two 36-inch mains through Fifth Avenue to the slight eminence known as Murray Hill, where the reservoir which forms the subject of this article was constructed, with a capacity of 21,000,000 gallons. From Murray Hill the water was conveyed in two 36-inch pipes down Fifth Avenue to Twenty-third Street and thence to Broadway. The two mains ran down Broadway to Fourteenth Street, where they separated, one continuing beneath Fourteenth Street to and down Avenue A and the other continuing down Broadway to the lower city. Such was the water system as laid out and built in the late thirties and early forties, and the excellent work that was put into every detail of the construction is witnessed by the unfailing service which the system has rendered to New York for half a century. The whole scheme is highly creditable both to the municipal administration of those days and to the skill and conscientious work of engineers and contractors.

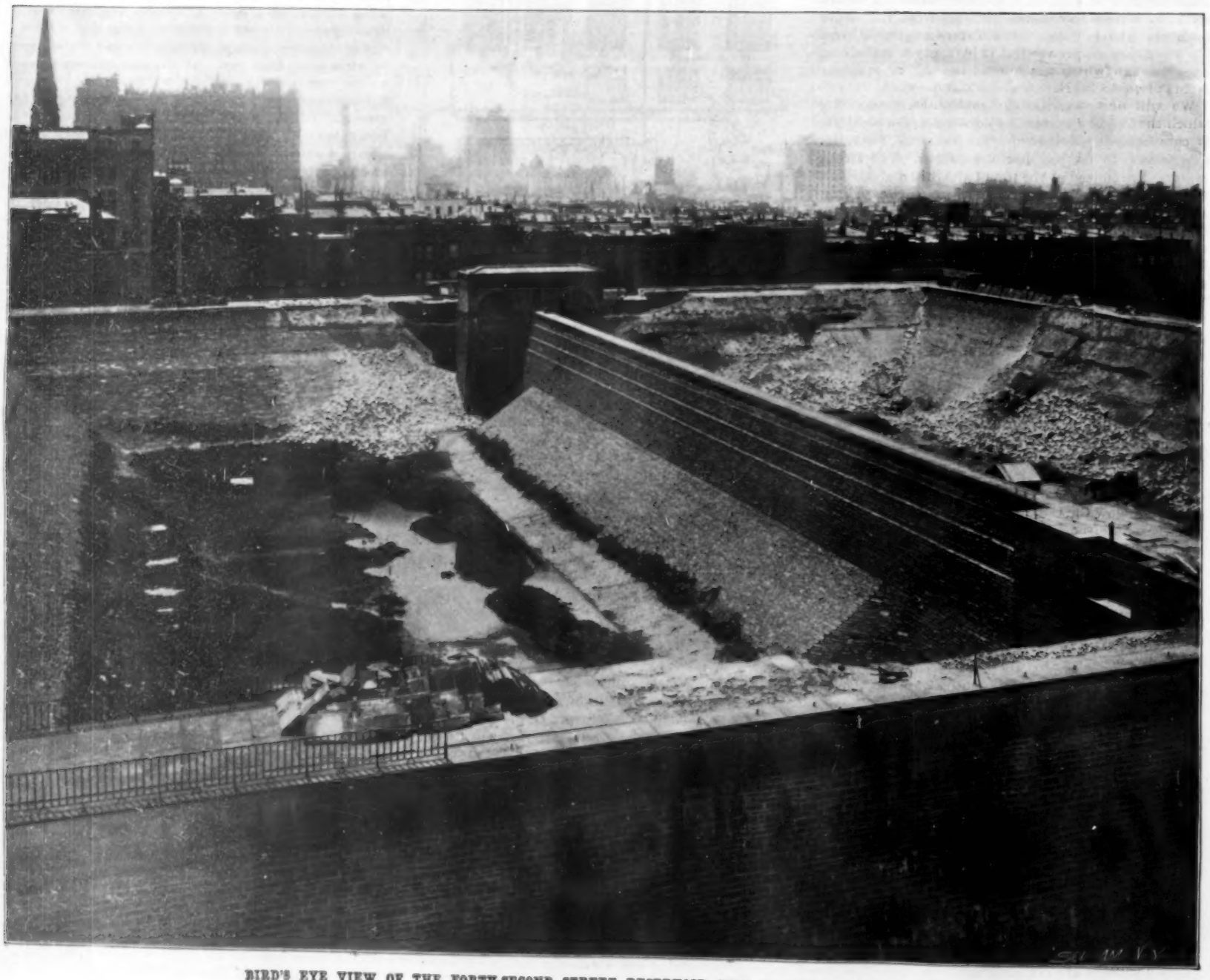
The original waterworks have been supplemented by the construction of new reservoirs at Central Park, and additional storage reservoirs in the Croton watershed, while the new Croton Aqueduct, with a daily capacity of 313,000,000 gallons, has been carried mostly in tunnel through the hills between the Croton Dam and the northern limits of the city. A vast storage reservoir of 2,000,000,000 gallons capacity is being built at Jerome Park, and a huge dam, the loftiest in the world, is being carried across the Croton Valley a few miles below old Croton Dam, which will create a lake of 30,000,000,000 gallons. These works and the various other dams of the Croton watershed will afford a total supply for New York city of about 75,000,000,000 gallons.

For many years the old Murray Hill Reservoir has lain idle, and now the site which it covers is being cleared to make way for the handsome building which is to form the future home of the New York Public Library. The structure is four-square and measures 420 feet from coping to coping The outer walls are double and hollow, and the basin is divided by a solid wall of masonry, which bisects it on a north and south line. Judged on grounds of construction, the summit of Murray Hill was an ideal site, for the reason that it was found to be covered to a depth of from 5 to 35 feet with an impervious clay that worked up into excellent puddle for backing up against the outer walls. By studying the sectional views, it will be seen that the main wall consisted of an outer inwardly sloping wall of 5 feet uniform thickness, an inner stepped wall 8 feet thick at its base, reducing to 2½ feet at the top, and a series of transverse walls, spaced 15 feet center to center and finishing at the top in a series of arched roofs. This is shown in the two sections, one taken in a horizontal and the other in a vertical plane through one angle of the main wall. The total width at the base of the wall is 30 feet, and it will be seen that it possesses great transverse strength and natural stability. The center wall is 30 feet wide at the foundation and 4 feet wide at the top, with a width of 15 feet for the major portion of its height. After the walls were built the clay was excavated from the center of each basin and banked and carefully rolled down against the inner face of the walls, being carried up over the arched roofs and finished off at the level of the coping, as shown in the sectional view. The whole interior of the reservoir was then paved with 15-inch blocks. The greatest depth from the floor to the coping is 42 feet, and the greatest depth of water is 38 feet, at which the combined capacity of the two basins is 21,000,000 gallons.

The first contract for the construction of the reservoir was let in 1839; it was finished in 1841 and opened in July of 1842. At the time of its completion it stood well out in the country, and Fifth Avenue was the only street that had been cut through immediately adjoining. Since that date the grade of Fifth Avenue



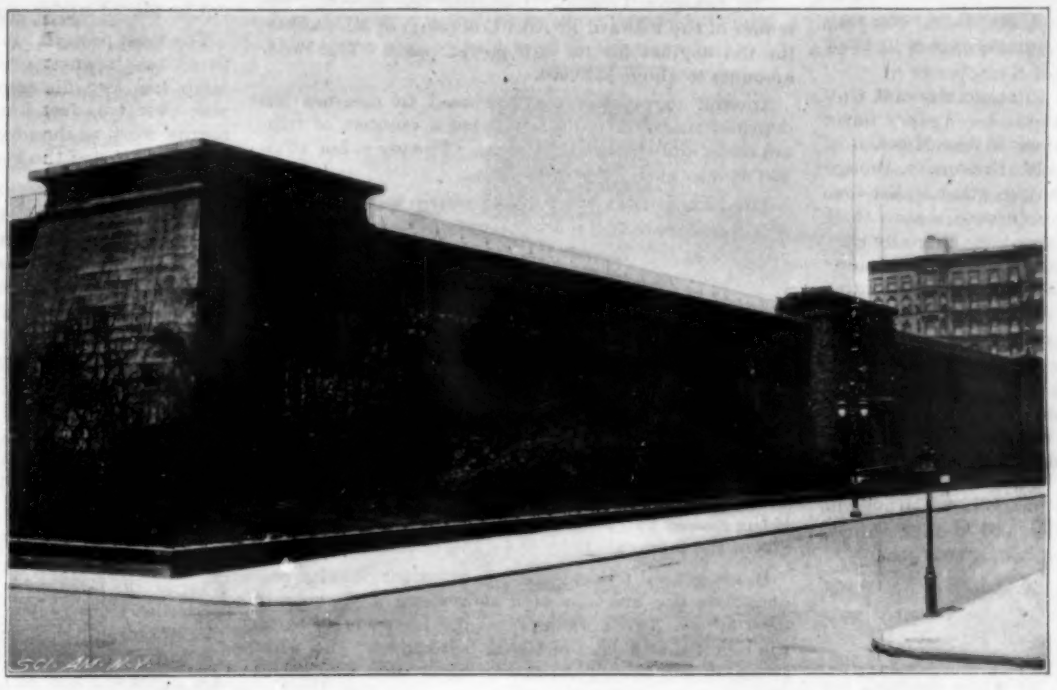

SECTIONAL VIEWS, SHOWING CONSTRUCTION OF FORTY-SECOND STREET RESERVOIR, NEW YORK.



BIRD'S EYE VIEW OF THE FORTY-SECOND STREET RESERVOIR, NOW IN COURSE OF REMOVAL.

has been lowered 7 feet, and it is this lowering of the grades on three sides of the reservoir that accounts for the retaining walls that surround it, the earth on the inside of these walls representing the original level of the ground.

The amount of material in the reservoir proper required by the contract to be removed is 106,000,000 cubic yards; but the contract also includes the building of the foundations for the new library, the price for removing the reservoir being $105,000, and for putting in the foundation $273,000. As the structure now lies in the very heart of a great city and abuts on one of the most fashionable avenues in the world, the work of removal cannot be done in the wholesale, rough-and-ready methods that would be adopted if it were to be done in the open country. The walls have to be taken down with as little interference with street traffic and as little inconvenience to the residents in the neighborhood as possible. Accordingly, two openings, one into each basin, were cut through the outer walls at the entrances on Forty-second and Fortieth Streets, and through these the contractor's teams are carting out the clay banks and the stone with which the interior slopes and floor are paved. The walls are meanwhile being torn down on all sides, and such of the stone as is suitable is being stored for rebuilding into the structure of the new library. The contract time for removing the reservoir is six months, but it is already evident that the restricted conditions under which the work is being done will delay its completion many months beyond the contract date.



THE RESERVOIR, FROM JUNCTION OF FIFTH AVENUE AND FORTIETH STREET.

## THE LAST ERUPTION OF MAUNA LOA.

BY ENOS BROWN.

After a rest of twelve years the great volcano Mauna Loa, on the morning of July 4, burst forth in magnificent eruption. Previous to this time earthquakes had been frequent, not only in the island of Hawaii, but in the neighboring islands as well. At sea seismic disturbances had been reported by returning vessels, and even as far distant as the western coast of the North American continent, earthquakes of considerable violence indicated a volcanic outbreak somewhere among the active craters in the islands of the Pacific.

For some days previous to July 4, the craters of Maukua-wéo-wéo, which includes all those in the neighborhood of Mauna Loa, gave indications of an early eruption, and the Volcano House was unusually crowded in anticipation of a chance of witnessing the sublime spectacle. At two in the morning a tremendous explosion awoke the visitors, and looking toward the summit of Mauna Loa it was seen that a new crater, 5,000 feet below the top, had opened, from which great columns of smoke and fire were being ejected, while rivers of lava were flowing down the mountain side.

The eruption was accompanied by tremendous explosions, felt throughout the island of Hawaii. Far above the crater a column of fire, a thousand feet in height, was thrown by internal forces. White heat rocks were ejected and falling back to earth again shook the whole mountain to its base. In less than ten days the river of lava reached a point within a few hours' walk of the city of Hilo, causing immense alarm and dire foreboding. Another stream flowed in an opposite direction. Both were of immense dimensions and moved with great rapidity. Fortunately, after three weeks of the most magnificent demonstrations the violence of the eruptions sensibly abated, and thus a calamity which had every appearance of equaling that which afflicted Hawaii in 1887 was happily averted. Several parties, at great risk, approached the new crater during the eruption and describe the scene as one of sublime power and magnificence.

MAUNA LOA IN ERUPTION.

The lava was of about the consistency of oil, and in its course to the lower levels of the mountains flowed with great rapidity—a mountain torrent of fire falling down in blazing cataracts, covered by dense clouds of steam and sulphurous vapor. In places it passed through forests of timber, which ignited and fell into the fiery stream, where they were quickly consumed. Persons who have witnessed all the eruptions on the island for the past fifty years predicted, from the violence which this eruption maintained during its brief continuance, a greater disturbance than those of 1823, 1840, 1852, 1855, 1859, 1868, 1881 or 1887, which are historic.

The first record of Hawaiian volcanic action observed by white men was in 1789. In 1823 Kilauea continued in eruption for three years. In 1840 the bed of the crater of the same volcano sank 300 feet and another one opened lower down, from which flowed a lava stream 200 feet deep, 1 to 3 miles wide, and 30 miles long; and again, in 1852, for 20 days, a column of molten lava, 700 feet high and 300 feet in diameter, was ejected. In 1855 a stream of lava 3 miles wide, sometimes expanding into broad lakes 8 miles wide, flowed for six months from the top of Mauna Loa, and approached within 6 miles of Hilo. This eruption lasted for 18 months, and 300 square miles were covered. In 1859 a great stream issued from Mauna Loa and flowed 60 miles in 8 days.

In 1868 Kilauea was in a state of violent eruption. One thousand earthquake shocks occurred in five days, and on April 2 a torrent of mud half a mile wide and a hundred feet deep flowed from the crater. The eruption of 1881 was of extraordinary violence, and the lava flow from Mauna Loa approached within fifteen minutes walk of Hilo. It was scientifically demonstrated that the flow of 1881 amounted to no less than 2,200,000,000 cubic feet of lava. Hilo was again threatened with destruction in 1887. It is believed that the volcanoes of Hawaii are diminishing in their power, as the records for half a century or more indicate both a decrease in duration and in violence as well. The view accompanying this article is from the studio of L. L. Williams, of Honolulu, who spent several days at the summit of Mauna Loa during the last eruption.

### Automobile News.

"The Automobile Club of America" has been incorporated. According to the articles, the objects of the organization are "to maintain a social club devoted to the spread of automobilism and to its development throughout the country; to arrange for through runs and to encourage road contests of all kinds among owners of automobiles."

On August 19, Mr. and Mrs. John B. Davis reached Detroit. The number of breakdowns which they have had is stated to be twenty-five, and the trip has been abandoned. It would have been interesting to see, if the carriage had ever reached San Francisco, how much of the original machine would be left. So far, the trip has been not a particularly good brief for the American motor carriage. The natural inference is that our carriages are too light for the rough service which is entailed and the badness of many of our roads.

The Paris-Rouen-Dieppe-Rouen race is announced for August 27, and a motor vehicle race organized by the Bavarian Automobile Club has just been run between Innsbruck and Munich, a distance of 173 kilometers. According to The Motor Car Journal, there were eleven starters. The winner, Baron de Dietrich, did the journey in five hours thirty-eight minutes. A motor car race between Berlin and Dresden is being organized in connection with the forthcoming automobile exhibition in Berlin. It will be run on September 18.

THE papyrus plant grows nowhere in Europe with the exception of the banks of the river Cyane in Syracuse, Sicily. It is generally believed that it was introduced from Egypt by the Syracusan rulers in the day of their intimate relations with the Ptolemies, but it has also been suggested that the Saracens introduced it from Syria. An illustration of this remarkable growth appears in the current issue of the SUPPLEMENT.

THE income from the war revenue taxes for the last fiscal year was $102,617,763; over $37,000,000 was obtained from stamp taxes.

### Science Notes.

Miss Anna Klumke, of California, is a painter of note. Her sister is known all over the world as the holder of an important position in the astronomical observatory at Paris. Miss Anna Klumke inherits all of the property of the late Rosa Bonheur.

It is feared that over-indulgence in tobacco may have a prejudicial effect upon the Latin-American peoples, especially those in South America. According to Prometheus, not only do children of two or three years smoke all day long, but mothers have been seen trying to quiet their babies by putting cigars in their mouths.

In the annual report of Prof. Eliot, of Harvard University, it is stated that Dr. Alexander Agassiz never received any salary for his services to the Museum of Comparative Zoology of Harvard University, though his services have been most important. Between 1871-97 he has expended from his private means three quarters of a million dollars without making any communication on the subject to the President. In addition to this he has made considerable gifts to other University objects.

At the Paris Exposition there will be no lack of curious shows of all kinds. One of them will be a kind of "religious Tussaud's." It will be a retrospective history of the interesting phases of nineteen centuries of Christianity. There will be scenes of old convent and monastic life, and the squire's vigil in the castle chapel on the eve of his knighthood will be accurately portrayed in wax. There will also be missionaries from the Congo, with man-eating negroes and similar things. There will also be a collection of books, etc.

Statistics obtained by sunshine recorders are interesting. Some curious facts have been recently published by the French Meteorological Bureau at Paris. Spain has 3,000 hours of sunshine a year; Italy, 2,700; France, 2,600; Germany has 1,700, while England has but 1,400. The average fall of rain in the latter country is greater than that in any other European country. In the northern part and on the high plateaus of Scotland about 351 inches of rain fall a year, and London is said to have an average of 178 rainy days in the year and fully ten times the quantity of rain that falls on Paris.

Even works of art cannot escape from the psychologist and the medical man. Dr. C. H. Stratz points out some curious symptoms of disease in types represented in works of art. He finds that Botticelli's "Venus," in the Uffizi at Florence, is suffering from consumption and should not be riding across the sea in an open shell, without clothing. It is needless to state that nothing of this kind was ever attempted by the old masters; they selected types which appealed to them and painted them as they saw them, and it is practically time wasted to hunt up hidden meanings in works of art.

Prof. Dr. Emanuel Herrmann has proposed the introduction of a telegram-card, which will undoubtedly be used by the Austrian post office. The idea of Privy-Councilor Herrmann is to cheapen rapid communication by a combination letter and telegram, and special cards are to be used for the purpose. These cards are to be sent at half the price of the ordinary telegram. They may be dropped in letter boxes or may be handed into post offices, provided they are duly stamped. They are picked out at once and the contents, which is no longer than that in the ordinary telegram, is handed over to the telegraph operator, who sends it to its destination. The telegram is written on a special form and delivered by the letter carrier.

Athletes in training require special diet, and the athletic directors of Yale University have decided to make an important change in the system of conducting the training tables. Heretofore every branch of athletics had its own table, conducted separately from the others. This system has proved very expensive and unsatisfactory. Now all athletes will eat at the same table, or at least under the same roof. In the fall only the football players will go to the table. During the winter some of the oarsmen and trackmen will take their meals at it, and in the spring the base ball candidates will be taken to the table. It is probable that students who may not be actively engaged in university athletics may be allowed to attend if they so desire.

The icebergs of the south differ from those of the north as the Antarctic summer differs from the Arctic. This is caused by the difference in temperature between the summer of the Antarctic and the Arctic. This is due to the fact that while the latter region is a polar basin surrounded by vast tracts of land which retain the summer heat, the former is a comparatively small tract of land in a tremendous expanse of water which parts from its heat very quickly. An interesting article upon Antarctic Icebergs is to be found in the current SUPPLEMENT, as is also an interesting article on West Indian Hurricanes, written by an eye witness, and no one who has not seen the indescribably relentless fury of a West Indian hurricane can understand what it means.

### Engineering Notes.

A railway will be built up the Rax Alp, which is 6,400 feet high.

The statement that a serious accident had happened in a recent test of the Brown wire gun is false. The test was, on the contrary, a great success.

The Baldwin Locomotive Works have shipped 409 locomotives abroad in the year ending August 1, 1899. There are now 6,700 men employed in the works.

The Glasgow Tramway Company has accepted the tender of the Edward P. Allis Company, of Milwaukee, for the engines for its new power plant. The order amounts to about $570,000.

Aneroid barometers may be used to measure the depth of shafts in mines, provided a number of trips are made and the average taken. The car is not stopped at intermediate points.

The League Island dry dock, which was built only some eight years ago, is now being repaired. The workmen found on examination that the Southern yellow pine in the part below high tide was even more decayed than was expected.

The figures given in the London Coal and Iron Trades Review show that of the world's pig iron product of 1898, 78¼ per cent was converted into steel. In 1868 only 4 per cent of the world's pig iron product was applied to the manufacture of steel.

A test has been made with glasses which were intended to detect the presence of smokeless powder. The test was made under the direction of Col. Phipps. If the glasses had proved successful it would have been one of the most valuable inventions of recent years.

In his annual report Naval Constructor Bowles recommends the erection of a new stone and concrete dock at the New York navy yard. He strongly urges the removal of a part of the Cob Dock, and the construction of eleven piers extending out into Wallabout Channel.

Many of our readers are doubtless troubled with the waste of oil in the ordinary oil can. The Clay Record recently published an interesting wrinkle for avoiding this which, while not new, may not be generally known. File the end of the oil can spout off at a bevel. You can then slip it under the lids of the journals without touching them with the hands, and the stream of oil can be carefully directed.

Members of the Engineering Corps of the United States Army have cleared the Pasig River of a number of stone-laden canoes which were sunk to close the channel. The total value of the property recovered by the engineers is estimated at $750,000. Maps and topographical sketches of the country around Manila were made for the use of the army commanders, and the surveys were frequently made under fire.

The Holland submarine torpedo boat has been again tested in Little Peconic Bay. Torpedo trials were made as well as a test for speed and submergence. The torpedo was a dummy of the small Whitehead type and was blown from the tube by air pressure and was taken in a straight line for about 75 feet. There was hardly any disturbance in the water from the discharge of the torpedo, only a few air bubbles showing on the surface near the bow of the boat.

A Southern railway company is preparing to convert all of its dining cars into combination cafe and table d'hote compartments. It is thought that this plan will be popular, as some people prefer table d'hote, while others only wish a light repast and care to pay for only what they eat. On some Eastern roads it is almost impossible to obtain anything to eat on a long journey without taking a dinner in the regular dining car, and while the service is nearly always excellent, the food is sometimes indifferent.

The engineer who has charge of the survey for the proposed ship canal from the Great Lakes to the Atlantic Ocean has completed his preliminary work. The project is to cut a canal 30 feet deep and 340 feet wide from Lake Erie to Lake Ontario around Niagara Falls; then leaving Lake Ontario at Oswego, the canal will take the course of the Oswego River to Oneida Lake, and then through the Mohawk River to the Hudson River. The locks will be 1,000 feet long with walls 50 feet high. The most important problem connected with this project is to find storage for water to feed the great canal and not injure the water supply of manufacturing concerns.

Dr. Cleveland Abbe, in a recent lecture before the Franklin Institute, in speaking of the evolution of invention, said: "It is not science, or study, or art, it is simply a happy accident that brings to some one's mind two thoughts that are suddenly seen by the inventor to have an important relation to each other hitherto unsuspected. Those nations and individuals who are unfortunate as to climate, soil, vegetation, minerals, water power, etc.—those who have neither stimuli nor opportunities—did little. In proportion as we today associate ourselves with the highest science we bring forth the best inventions and manufactures. Prof. Abbe's interesting and scholarly lecture is given in full in the current SUPPLEMENT.

### Electrical Notes.

A few of the relics of Volta were saved from the disastrous fire at the Como Exposition. These include the original Voltaic pile, some letters, a few books from his library, and about fifty drawings, paintings, and medals.

The destruction of the Como Exposition has created a strong feeling among most of the scientists of Europe that hereafter important documents and apparatus relating to the history of science or to one man should not be placed under one roof.

The most powerful incandescent lamp ever manufactured was shown at a recent electrical exhibition. The lamp has two filaments in parallel. The lamp bulb was over two feet long, and it succumbed after three nights' work to the heat of the filament, which is said to have softened the glass at the neck.

Philadelphia will present the city of Paris with a statue of Benjamin Franklin, for the exposition. This will be a duplicate of the one in Philadelphia, which we illustrated a few weeks ago on the front page of the SUPPLEMENT. It is intended to place the statue in Passy, where Franklin resided when he was Minister to France from the United States.

An American electric manufacturing company has been awarded the entire contract for the equipment of numerous electrical plants which will be installed along the line of the Eastern Chinese Railroad. It will consist largely of temporary lighting plants. It is thought that ultimately $200,000 will be involved in the contract.

Niagara Falls is to be illuminated by electricity during the coming Buffalo Exposition. The idea is to erect a series of tall poles on both the American and Canadian sides of the river. On top of them will be placed search lights, and the colors of the lights which are thrown on the Falls will be constantly changed. Arc lights will also be placed in the Cave of the Winds, which will give to the water which falls in front of it a weird phosphorescent color. The current is to be obtained from the Falls itself.

Prof. J. E. Woodland, of the University of Worcester, Ohio, sends us an interesting account of the removal of a broken steel drill from the bottom of a well on a farm. An electro-magnet was constructed in the university laboratory and 600 feet of insulated wire was secured for the connection. The magnet was constructed of soft steel rod 1¼ inches in diameter and 3 feet long. It was wound with four layers of No. 12 wire leaving 4 inches of the end of the rod bare. A current of 6 amperes was maintained while the magnet was in the well and a voltage of 25 was obtained from storage battery cells. The pieces of the broken drill were satisfactorily removed.

In Germany the theft of electricity is evidently not considered a crime, for in a recent appeal which reached the Supreme Court, the court held that those properties are wanting in electricity which would be necessary to constitute it a movable object in the sense of the law, and electricity must be reckoned as one of the energies of nature, like light, sound, and heat. The laws relating to larceny provide only against the theft of movable bodies, and therefore would be considered inapplicable in this case. Three mechanics secretly attached wires to the circuit in the house where they lodged, and thus had their room lighted without expense. They were sentenced, and the case was brought to the Supreme Court, with the result which we have noted.

French barbers are very progressive. According to Electricity, a Paris barber shop has recently been equipped with a most elaborate electric plant. The water is heated electrically by means of a German silver tube in a soapstone case. The tubing is electrically heated, so that the water is nearly boiling when it passes out of the faucet. The curling irons, which often used to burn the hair, are no longer used for curling. The electric curling irons which take their place can be brought to any temperature, which they retain indefinitely. The hair is cut by clipping machines actuated by electricity; electrical devices are also used to singe the hair, which are much better than the time-honored taper. For singeing the comb a platinum wire is used.

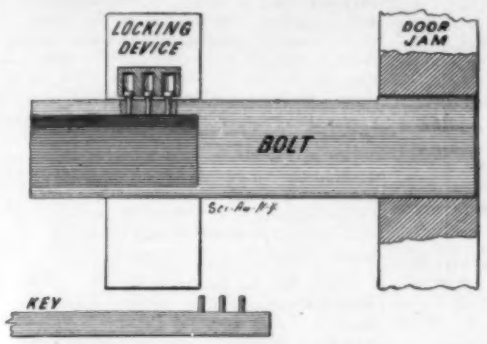
The western half of the underground trolley system of New York city was tied up for several hours on August 23, owing to a bad storm. The subway at Canal Street and West Broadway, through which runs the wires feeding the section of the line below Canal Street, became flooded, the wires burned out owing to their immersion, and left the cars without power to operate them. When the trolley system was first constructed the engineers had great difficulty at this point on account of a sewer which the lines had to pass at this point. The subway lies below the sewer and the stagnant water has been collecting since the construction of the subway. It did not make its presence felt until the date noted, when it obtained a sufficient depth to cover the feed wires and burn out the fuse. Horse cars were put on to enable passengers to make the rest of the trip. Men at once began to drain the conduit.

## ANCIENT EGYPTIAN VERSUS MODERN PIN LOCKS.

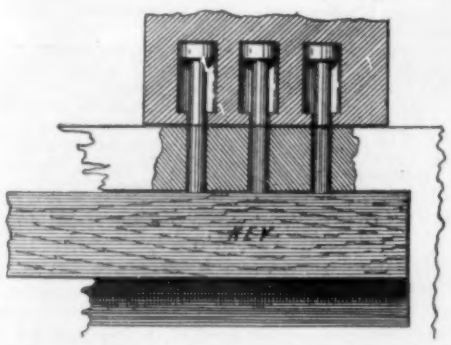
About as soon as the human race commenced to acquire property of any kind, it immediately began to devise safeguards for protecting its worldly goods from thieves. Homer mentions in his "Odyssey" a fastening to a door which resembles a leathern thong. This was placed in a hole in the door, the bolt of which was secured by means of a hook or ring attached to the thong. Often keys shaped like a simple crook were made of wood, as indeed many of the keys are still made in Oriental countries.

The earliest lock of which the construction is known is the Egyptian pin lock, which was used some 4,000 years ago, and, strange to say, the most perfect modern lock is based upon similar principles to those employed in the Egyptian locks. These locks are in use to-day in Egypt, and can be seen in any of the older streets of Cairo. Keys for Egyptian locks were and are thirteen or fourteen inches long, whereas the key of the gate of a public building was sometimes two feet in length. A great deal of importance was attached to these Oriental keys. They were the signs of authority and were carried on the shoulder of those who held any weighty office. The Egyptian lock, or "dabbeh," is placed on either the outside or inside of the door, and in a majority of cases they will be found on the outside.

Our engravings represent a typical Egyptian lock and the mechanism for working it. For our photograph of this lock we are indebted to the courtesy of Mr. H. H. Suplee, who kindly placed it at our disposal. The lock consists of two parts, the staple or locking device and the bolt proper, which slides back and forth, securing the door to the door jamb. The outside of these locks is often richly ornamented with inlaid pearl in Oriental designs, as in the present instance. The key consists of a block of wood in which a number of small iron pins, three, four, five or more in number, are secured. This key is thrust into a recess in the bolt, the rear wall of the recess limiting the lateral distance which the key can traverse. The key is raised and the iron pins pass through holes bored in the bolt and raise the pins of the locking device to a height which prevents them from interfering with the lateral motion of the bolt, so that if the right key is slipped in, the bolt can be moved forward and backward at will. The pins are provided with heads which prevent them from entirely slipping through the locking device and the bolt. The heads of the pins rise and fall in special channels provided for them. The




EGYPTIAN LOCK AND KEY, SHOWING BOLT LOCKED.

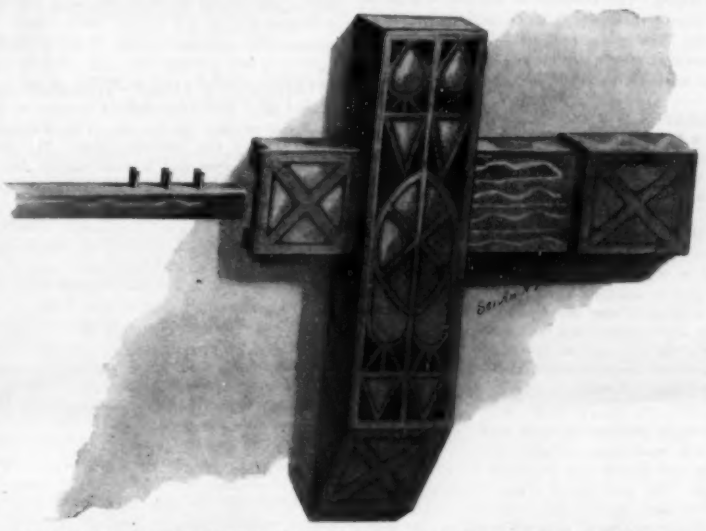



EGYPTIAN LOCK, SHOWING PINS FREEING BOLT.

pins in the key are all of the same height, and the pins, or pin-tumblers, as we may term them, for the locking device are also of the same height. By the insertion of a larger number of pins, and by arranging them irregularly in the locking device, the difficulty of picking the lock is increased. There is little trouble, however, for an expert to open a lock of this kind. If the picking instrument, as a bent wire, is inserted in the bolt, one of the pins could be raised, but the others would serve to hold the bolts securely; but if the front end of the bolt is seized and pushed and then the bent wire is used, the pins can be lifted one at a time and secured, the pressure on the bolt serving to bind them when they have been raised. One pin is taken at a time, while the pressure is on, until the last pin is raised, then back slides the bolt.

The same principle is carried out in what is called the Stansbury ward lock. This lock really had no wards or fixed obstructions, but it had a disk, and in the disk a series of holes, and in those holes are a number of pins forced forward by springs. The key has a number of pins on the end. The difficulty with this lock was that a blank key the size of the keyhole could be covered by wax, and by pressing it on the disk would show exactly where the pins are, and by this means another key could be made which would open the lock.

The most remarkable development of the pin lock is, however, what is known as the "Yale lock," which is an example of how the inventive American can take



VIEW OF ORNAMENTED EGYPTIAN PIN LOCK—FROM DAMASCUS.

a crude idea and make a remarkable invention from it. Linus Yale, Jr., who died in 1868, invented the Yale lock in the early sixties, and the fundamental patents have now expired. In its original form it had a thin, flat key, which, while affording great capacity for key changes, permitted the lock to be easily attacked by picking tools, although the lock did not yield readily. Subsequently the makers remedied this defect in a large measure by the invention of the corrugated key, and finally by perfecting what is known as the "Paracentric" key, which will be explained later on. The lock consists of a small barrel which turns in a cylinder in order to move the bolt.

The barrel is prevented from being turned by five divided pin tumblers which move up and down in the barrel and the cylinder. Each pin in the casing is forced down by a small spiral spring. The upper half of the pin in turn presses upon the lower half of the pin, which remains permanently in the rotatable barrel. When the key is out of the lock, the springs press the upper half of the pin down into the barrel, preventing it from turning and throwing the bolt. When the key is inserted, the pins are gradually raised until all of them in the cylinder are raised to the line between the barrel and the cylinder, while the lower half of the pin is also raised to the same point, permitting the barrel to be easily turned so as to throw the bolt. The key is provided with a beveled end, which enables it to be pushed under the pin tumblers so as to raise them easily. Should a false key be inserted, the steps would be too high or too low, so that some of the lower pins will be pushed up beyond the barrel into the holes above them, and the upper half of some of the other pins would undoubtedly drop so low as to also prevent the lock from turning. It will be seen at once that the same principle is involved in the Egyptian pin lock, and had invention stopped at this point, the lock would still have been a good one; however, Mr. Yale conceived the idea of making pins of different heights. This immediately caused the lock to be really safer than any other lock on the market. If only one pin was used, there would be 10 variations; with two pins there would be 100 changes; with three pins, 1,000 changes; with four pins, 10,000 changes; and with five pins, 100,000 changes. In other words, the number of changes which can be obtained with any number of pins can be figured by taking the power of 10 indicated by the number of pins; in other words, the number of pins would be the exponent of the figure 10. In practice it is found that about 30,000 changes are about all that is practical with a five-pin lock, owing to mechanical reasons. This alone would make the lock practically unpickable, but there is still another method of safeguarding it. The spacing of the different pins may be changed, and a single pin admits of another series of 30,000 keys, so that it will be seen that the lock is practically a safe one, as no thief could obtain anything like the requisite number of keys to attempt to open the lock.

Special types of locks are used for different purposes. Thus a post office may have Yale locks of a particular kind, and the company will not duplicate any key for this lock without an order from the proper authority. Should all the keys of a lock be lost, the lock can be taken off and sent to the factory; the length of the pins can be altered, and new keys made, so that the old keys will fail to operate the lock. It was found in practice that there was some danger of the lock being picked by instruments. The corrugation of the escutcheon and the passage in the movable barrel prevent this. Although the difference between the old and the new Yale lock is small in appearance, still there is little comparison between the safety of the two.

It is interesting to know that the Oriental used his pin lock for thousands of years without thinking of making an improvement which would make it comparatively safe, while it was reserved for the ingenious American inventor to take the clumsy old device and to transform it into a safe and remarkably interesting lock.

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TURKEY is the last place where one would expect an exhibition, but even that country appears to have been struck by the wave of progress and the imperial government has decided to organize a permanent agricultural exposition in Constantinople. It will be installed in the premises of the Yildiz Relief Exhibition and will consist of two sections, one for cultivated plants and the other for domestic animals. Agricultural implements of the latest American type will be exhibited and the use of such machinery and implements will be taught to agriculturists by Americans who will be specially engaged by the government.

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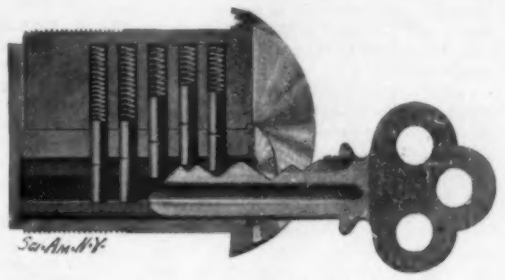
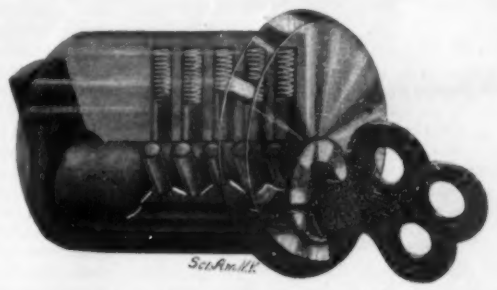
### The Current Supplement.

The current SUPPLEMENT, No. 1235, has many articles of the greatest possible interest. The first page is occupied by an illustration showing three burning oil wells in the fields of Bibi-Eybat. "The Relations of Physics and Astronomy to the Development of Mechanical Arts" is by Prof. Cleveland Abbe. "The Theory of Sleep" is by Prof. A. L. Herrera. "The Recent Excavations of the University of Pennsylvania, at Nippur," by Prof. H. V. Hilprecht, is an illustrated description of explorations of the greatest interest, and the paper is admirably illustrated. "The Papyrus Plants of the River Cyane, at Syracuse," is an illustrated description of one of the most beautiful spots in Europe, the tasseled papyrus plants overhanging the clear stream Cyane; the papyrus plant grows no where else in Europe. "West Indian Hurricanes" is an original article by Dr. Eugene Murray-Aaron, and is of great importance owing to the recent devastation wrought by a hurricane in Porto Rico. It is accompanied by an illustrative map. "The Importance and the Promise in the Study of Domestic Animals" is a paper by Prof. Simon Henry Gage, of Cornell University, and is the opening address before the section of



YALE LOCK WITH KEY PARTLY INSERTED.



KEY FULLY INSERTED RAISING PINS TO UNLOCKED POSITION.

zoology of the American Associaton for the Advancement of Science at their Columbus meeting.

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## RECENTLY PATENTED INVENTIONS.

### Agricultural Implements.

HAY-STACKER.—HENRY PARRENT, Gilledge, Mont. The invention relates to that form of stacker in which the hay is loaded into the wagon on top of a rope-sling arranged to be hitched to a rope running to a pulley on an elevated support and thence extended to the snatch-block, so that the entire load is, in one operation, pulled off the wagon, raised and dumped. The stacker-wagon in this invention has inclined plank skids extending from the floor to a support on the front end of the body and thence over and above the team, so as to allow the team to be driven directly under the elevated platform and the load to be taken from the wagon directly over the team.

MACHINE FOR REMOVING PITH FROM CORN-STALKS.—GEORGE R. SHERWOOD, Kearney, Neb. It is the purpose of the inventor not to split the stalks entirely, but to leave them unsplit at one side - an end which is attained by a novel arrangement of splitting disks and presser-shoes. The stalk, after being split by a disk, is received by a saddle by which it is straddled and supported while it is being acted upon by pith-removing devices. After this main operation is completed, the stalks are subjected to the supplementary action of a finishing brush, which removes any particles of pith which may still adhere to the stalk. It is probably a new departure to subject the pith in the stalks to a final or finishing action after the main pith-removing operation.

### Electrical Apparatus.

TELEPHONE SYSTEM.—MALCOLM S. KEYES and JAMES H. SPENCER, Manhattan, New York city. These inventors have devised a telephone system designed for use in stores, factories and hotels, and arranged so that the several stations in the system can be readily connected without the use of an expensive exchange. Each station in itself forms a central station, and but one movement for a call is necessary whether the receiver of the other station be on or off. The invention comprises principally an induction-coil having both primary and secondary coils connected by wires with the several stations to form circuits, a receiver in one induction-coil circuit, and a transmitter in the other.

ATTACHING-PLUG FOR FLEXIBLE-WIRE CONNECTIONS.—DANIEL MCGLONE, Long Island City, New York city. By using this plug, the electric lamp or other device can be moved about without twisting the wires, and thereby causing a bad electric connection. The plug is arranged for attachment to the supporting-fixture connected with one of the line-terminals. A carrier of insulating material is mounted to turn on the plug and carries two circuit-conductors for the wires, one conductor being in contact with the plug and the other being arranged for contact with the other line terminal.

### Mechanical Devices.

MOTOR APPARATUS.—JOHN E. TYLER, Roxobel, N. C. This improvement in motor apparatus embodies a series of tanks, connecting pipes, and pumping and driving mechanism, whereby a circulation of water from tank to tank will effect the continuous operation of the actuating devices and a readjustment of water from tank to tank to secure the desired operation of the parts. The pipe connection between the tanks is controlled by a valve operated by a cylinder and piston. Electrically-operated devices control the supply of power to the cylinder. A float operated by the liquid in the pipe connection makes and breaks the circuit in the electrically-operated devices.

CARRIAGE-SHIFTER AND LINE-SPACER FOR TYPE-WRITERS.—JAMES M. CRAMER, Santa Margarita, Cal. The present invention provides improvements in carriage-shifting and line-spacing devices for type-writers. The shifting device is of simple construction and will quickly return the type-writer carriage to its initial or starting position after being released by pressing upon a key. The device is so placed that it will not interfere with the ordinary working of the machine or change its appearance. A simple line-spacing device operated by the carriage is also provided.

### Railway Appliances.

SPIKE-PULLER.—WILLIAM FIELDEN, Port Oram, N. J. The spike-puller comprises a bed-plate adapted to rest on the top of a railway-rail, a fulcrum-block mounted to rotate in a horizontal plane on the plate, a lever fulcrumed in the block, and jaw-carrying levers carried by the first lever. The parts are so arranged that the device can be moved from place to place along a rail or any number of connected rails, and that the gripping-jaws can be shifted from one side of a rail to the other without lifting the device.

### Miscellaneous Inventions.

DIE-PLATE FOR EMBOSSING-MACHINES.—JOSEPH EBERHARD, 317 Ten Eyck Street, Brooklyn, N. Y. This improved die-plate is covered with small screw holes and the metal die is fastened to it in the proper position to register with the celluloid die. As the screw holes are quite small and very numerous, the plate being completely covered with them, the die may be adjusted very accurately.

DEVICE FOR APPLYING WALL PAPER.—ALBION W. FOSTER, Millbridge, Me. This device consists of a flat back piece from the side of which protrudes a row of bristles. Mounted on the back piece above the bristles is a roller for applying the paper. The sheet of wall paper is thrown over this roller, and while being matched with one hand is easily applied with the other by means of the roller and brush. The tool is provided with an extensible handle.

NON-REFILLABLE BOTTLE.—SALVATOR PENNY, 358 West 11th Street, New York, N. Y. In the neck of the bottle is placed a flat conical valve, which is covered by a movable plate having scalloped edges. A conical ring rests on this plate, and its small end fits loosely in the bottom of the stopper proper, which is cemented in the upper end of the neck. This stopper has a central opening for a cork, and when the cork is in place, it presses down the conical plug tightly against the valve, keeping it closed. The bottom portion of the stopper tapers and is smaller than the neck. Horizontal holes run through it and small lugs also project. When the bottle is being emptied, the liquid passes out from the valve through these holes to the main opening. The lugs engage a spring, which holds the valve closed more securely.

PROCESS OF SEPARATING PRECIOUS METALS FROM ORES.—WILLIAM H. BAKER, Deadwood, S. D. The pulverized ore is first submitted to the action of a potassium cyanid solution, in then thoroughly agitated by beaters, and heated to the boiling-point by steam. The solution is next separated from the tailings. The tailings are washed with the solution in the boilers, the steam thus produced being used in heating a subsequent mass of ore and cyanid. The solutions in the boilers, after becoming heavily charged with the metals, are evaporated to dryness. The residue is then fused to a red heat and allowed to cool, after which the saline mass is dissolved in water, leaving a residue of gold and silver in a porous state.

APPARATUS FOR CLEANSING BEER PIPES.—WILLIAM A. SCHMIDT, Manhattan, New York city. The apparatus consists of a portable boiler, on top of which a small retort is mounted. A bell-shaped cover is clamped to and separated from the retort by a perforated partition upon which are placed the cleaning chemicals. A valved pipe connects the boiler with the retort, and from the side of the latter projects a short valved pipe adapted to be fastened to the beer-pipes. This horizontal pipe is connected with a vertical, valved pipe which terminates near the bottom of the boiler. By properly manipulating the valves, water, steam, or a mixture of the two, may be forced into the pipes. The steam gradually dissolves the chemicals and carries them along to cleanse the pipes.

TARGET.—WILLIAM PARNALL, Bristol, England. This invention provides an indicating mechanism for targets, which mechanism comprises a dummy target having a centrally pivoted lever adjustable in various angular positions. The lever carries a plate containing a flap colored the same as the plate when closed, but showing some brilliant contrasting color when opened. By means of this flap, the position of the bullet is located approximately. Both the target and the signal target are mounted in an upright frame, suitably pivoted and balanced by counter weights, so that one may be swung down and the other up, or vice versa, by moving a small lever.

FIRE-ESCAPE.—MARY K. MCGOWAN, Brooklyn, New York city. An endless rope ladder passes over two drums, one at the top of the building hung from springs and the other at the first story, held from moving upward by projecting arms having longitudinal movement. The upper drum is suspended from a movable carriage, which allows of the ladder's being shifted to any position along the front of the building. Rope loops are provided in the rooms of the building, and these are intended to be hooked to the rungs of the ladder in order to support a person while descending.

WEATHER-SIGNAL INDICATOR.—THEODORE A. and HELEN B. FROEHLICH, Manhattan, New York city. This indicator is designed for use in schools. It consists simply of an upright post mounted on a square base having beveled edges. A vane is pivoted on top of the post over the usual letters indicating points of the compass; while on a wire support parallel to the post miniature weather signals are displayed. Thermometer, barometer, cloud, and wind-scales with pointers are mounted on each of the four beveled sides.

TROLLEY.—HERBERT HIRSCHMAN, Salt Lake City, Utah. The invention provides an attachment for preventing trolley-wheels from jumping the wire, although permitting them to pass freely any obstructions. Two standards are clamped to the fork of the trolley-wheel; and on the top of these are pivoted transverse arms crossing the wire and overlapping in the center. The arms are held in place by coiled springs on the outer side of each standard, and will immediately fly back into place after passing a switch or other obstruction. They will be separated when the rope is pulled, thus allowing the trolley to be placed on the wire.

MOORING DEVICE.—FREDERICK B. LANGSTON, Brooklyn, New York city. An ordinary mushroom-anchor is provided with a hollow shank through which passes a hollow tube, pointed at its lower end, and projecting a short distance below the anchor. Air or water under pressure is forced through the tube and escapes through the bottom, loosening the mud or sand sufficiently for the anchor to be embedded. A funnel-shaped opening in the top of the shank permits of finding the embedded anchor when the mud is loosened, if it be desired to raise it.

UMBRELLA-CARRYING DEVICE.—SOPHIA MCCRAE, Manhattan, New York city. This device consists of a simple strap provided with a small ring at each end. The strap is the length of an umbrella rib; and when not in use one of its rings passes over the tip of a rib and the other over a ferrule. A snap-hook fastened to the upper ring is made to engage a ring on a chatelaine-chain, when it is desired to carry the umbrella; and a short chain connected with this ring passes around the handle, thus holding the umbrella securely in place.

FIFTH-WHEEL.—JAMES K. THOMA, Winfield, Kan. This invention provides a ball-bearing fifth-wheel for wagons and carriages. The wheel is divided into four quarters by spokes in the top member; and near the end of each of these spokes is a hole in which fits a steel ball. These four balls give a bearing surface, although they have no lateral movement. A single ball is also placed in each of the four arcs into which the raceway is divided. These balls move laterally when the carriage is turned.

STEAMER-CHAIR.—ARTHUR H. PENNOCK, Kingston, Jamaica. The chair consists of a rectangular frame made of side pieces with a rung connecting them at the top and bottom. A similar leg near its center frame is pivoted to this main frame at right angles. The leg-frame is provided with two cleats, and on the upper cleat are pivoted two latch pieces. The seat-frame is pivoted to the main frame about half way between the floor and the leg-frame. A strip of canvas extends from the rung at one end of this frame to the rung at the top of the main frame, forming the seat of the chair. The other end of the seat-frame has a number of rungs so placed that when the frame is in position between the cleats it may be adjusted and held firmly by the latches.

PROCESS OF MAKING SUPERPHOSPHATES.—GEORGE SCHÜLER, Stettin, Germany. This process consists in boiling certain proportions of phosphoric acid and finely ground phosphates together, and, after they have cooled, in drying, grinding, and sifting them. The resulting superphosphate contains 47 per cent. of phosphoric acid soluble in water, and only ¾ per cent of insoluble acid. By this process lime and other low grade phosphates may be successfully used in manufacturing superphosphates.

STRINGED MUSICAL INSTRUMENT.—FREDERICK STROH, Bronx, New York city. The instrument consists of a violin, a cithern, and a mandolin arranged side by side on one base and sounding board. One end of the violin portion of the instrument projects so that the bow may be readily drawn over the strings. The instruments may be played separately or together by two performers.

FISHING-LINE FLOAT.—ALPHEGE BOURKE, Valparaiso, Ind. The improvement consists in placing a small coil of wire on the side of an oval-shaped cor float, between the two end edges. The line passes through these eyes and between one of the wire coils, where it is held securely. This arrangement permits of adjusting the float quickly and with ease.

BUTTON.—HEINRICH KINDMANN, Brooklyn, New York city. The button is in two parts, the button proper and the back. The latter part contains a funnel-shaped groove adapted to receive metal prongs on the back. The prongs pass through a hole in the fabric and are forced into the groove by special machinery.

JAR FOR WELL-DRILLING TOOLS.—HARRY W. RANK, McDonald, Pa. The invention provides improvements in jars used in connection with well-drilling apparatus for the purpose of shaking the drill loose whenever it binds in the rock. The jars consist of interlocked chain-like links, which are slotted. One link has its cross-head passing through the slot of the other. Each link is formed of a solid piece of highly-tempered metal, the side parts or reins having their temper reduced slightly. Thus the knocking heads are left very hard to withstand the battering and the reins are toughened to withstand the tensile strain.

MAGAZINE PLATE-HOLDER.—WILLIAM F. FOLMER, Brooklyn, New York city. The plate-holder consists of a box having a light-tight bag on one side. The plates are inserted through the back, which is removable and has a spring pressing them forward. The holder is attached to the camera in the usual way; and a slide is drawn to make the exposure. The front plate is then moved sideways into the bag, where it is grasped by the fingers and thrust in at the back end of the holder.

GATE.—CHARLES STEEL, Ethridge, Tenn. The gate is supported upon two parallel frames which move together and swing it to one side. An upright on one of these frames carries a cross-arm parallel with the frame; and a cord connected with this cross-arm moves the gate, first unlatching it by tightening a cord connected with a latch.

CHURN.—JAMES W. MAXEY, Plymouth, Ind. The churn is mounted on a simple frame on which is also placed a hand wheel adapted to drive the churn by a belt. The driving mechanism of the churn is detachable and is located entirely above the cover. The mechanism consists of a vertical shaft turning in ball bearings and having a pulley on top. A small door in the cover of the churn permits of examining the contents.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## NEW BOOKS, ETC.

INDICATING THE REFRIGERATING MACHINE. By Gardner T. Voorhees, S.B. Chicago: H. S. Rich & Company. 1899. 16mo. Pp. 179. Illustrated. Price $1.

The problems concerning refrigeration are comparatively new ones, and any aid which the mechanical engineer can obtain in solving them is sure to be warmly welcomed. The author is a mechanical engineer for a Boston cold storage company, and is therefore well fitted for performing such a task. The tables are certain to prove of great value.

TRANSMISSION DE L'ENERGIE ELECTRIQUE PAR UN FIL ET SANS FIL. Application du système aux communications télephoniques et télégraphiques et aux signaux Électriques en Général. Par Emile Guarino-Foresio. Liege. 1899.

TÉLÉGRAPHIE ELECTRIQUE SANS FIL. Répétiteurs. Par Emile Guarino-Foresio. Liege. 1899.

**Steam Engineering.**—We have received the first number of the periodical of this name. It is a consolidation of "Live Steam" and "The Engineer's Magazine" and is published by The Industrial Press, 9 Murray Street, New York city. The first number is highly satisfactory. There is a great opportunity for a paper of this kind, and the first number is an earnest of even more satisfactory issues to come. It is filled with valuable matter, and the illustrations and diagrams are well executed and printed. It is published at $1 per year.

**We have received the "Electric Railway"** number of Cassier's Magazine. We have on other occasions reviewed two notable numbers: the "Niagara Number" and the "Marine Number." The "Electric Railway Number" is fully up to the high grade of the other two. It consists of 292 pages of reading matter and over 300 illustrations. The articles are all written by specialists and they number eighteen in all. The whole forms an elaborate text book of modern street railroad construction and we congratulate our contemporary upon the production of such a handsome periodical. The number is mailed on receipt of fifty cents, and it is beautifully printed on fine paper.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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## Notes & Queries

### HINTS TO CORRESPONDENTS.

**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

**Buyers** wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

**Special Written Information** on matters of personal rather than general interest cannot be expected without remuneration.

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**Books** referred to promptly supplied on receipt of price.

**Minerals** sent for examination should be distinctly marked or labeled.

**(7713) F. A. G. writes:** I have expected weekly to see an account in the SCIENTIFIC AMERICAN of the alleged discovery of a new and powerful source of electricity, which is creating quite a sensation in New York at present. Can you tell me the nature of the fraud, for such a discovery is improbable? A. We are frank to say that we do not know to what this inquiry refers. We only know what comes under our notice. But when one wants information of this sort, it is a great assistance to us if he will inclose the clipping which has attracted his attention to the matter, or give as clear an account as he can of it. We receive a great many inquiries that are so indefinite as to be impossible of answer. We must make this one the basis for the request to all our esteemed friends to state their cases as fully and exactly as possible, and we will be as helpful as possible.

**(7714) C. L. E. asks** (1) why the gas generated from calcium carbide and water is called acetylene. A. The acetylenes are a series of compounds of carbon and hydrogen in which the hydrogen molecules are two less than twice as many as the carbon molecules, or algebraically the formula is $C_nH_{2n-2}$. There are several members of the acetylene series. The one which is used for lighting, and which is popularly called by the name of the series, has, in chemistry, the name ethine. 2. Why the name of X rays is given to the Roentgen rays. A. The name "X" was applied by Prof. Roentgen to the rays which he discovered, to denote their mysterious or unknown character. As every one knows, X is used in algebra for the quantity whose value is unknown or to be determined. Others have applied the professor's own name to these rays, and in time it is probable the name X will pass out of use, and Roentgen take its place.

**(7715) W. W. P. asks** how to connect Leyden jars whether in series or multiple. A. For experiments with a Leyden jar battery, connect the jars in multiple. To connect them in series each jar must be insulated from the earth. On discharging them you only get the effect of one jar. In multiple, the quantity of electricity is greater in proportion to the number of jars.

**(7716) F. K. S. asks:** Could you give me a formula for making a paste for mounting photos on glass (face next the glass), and directions for making same?

| | |
|---|---|
| A. Gelatine | 4 oz. |
| Water | 16 " |
| Glycerine | 1 " |
| Alcohol, 90 per cent | 5 " |

Swell the gelatine, use hot and avoid air bubbles.

**(7717) J. I. asks** how vibrations of 288,224,000,000,000,000 per second are measured. A. The number of vibrations per second performed by a wave motion such as that of light is not measured directly; but is determined by calculation. The wave length is first found, and the number of vibrations per second is then found by dividing the velocity of light by the wave length. This process is the same as finding the number of steps a person must take in walking a mile by measuring the length of one step and then dividing the mile by the length of one step. Your next question would

probably be, How are such short wave lengths measured? Wave lengths of light are measured best by diffraction gratings. This process is described in any text book of higher physics, such as Barker's or Ganot's. Wave lengths above those of light are inferred from their distance above the extreme limit of the light spectrum, as shown in a photograph of the normal spectrum. The wave length of Roentgen rays is a matter of speculation largely.


### TO INVENTORS.

An experience of fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.


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**AUGUST 22, 1899,**

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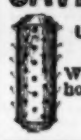
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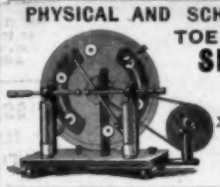
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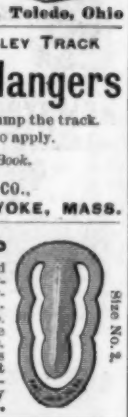
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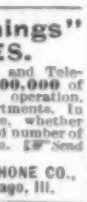


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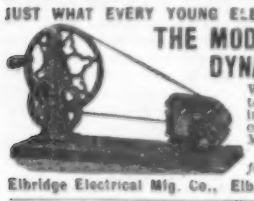

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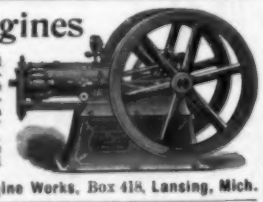

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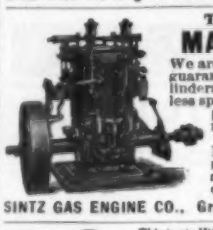

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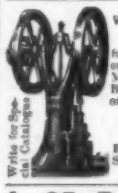

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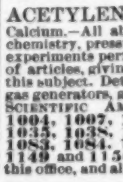

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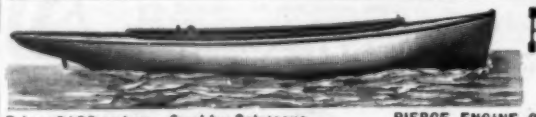

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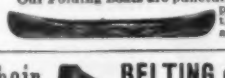

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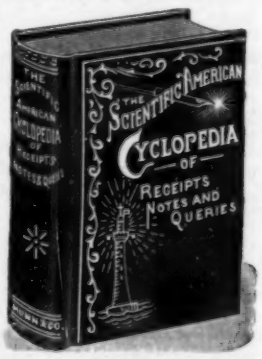


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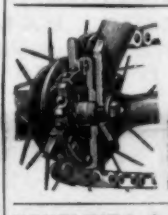

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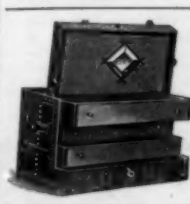

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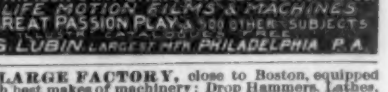


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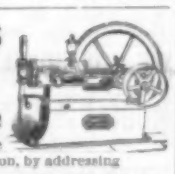

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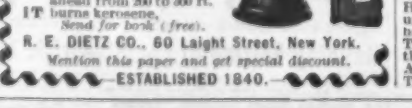

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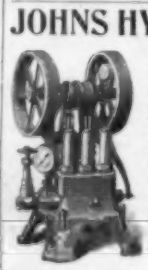

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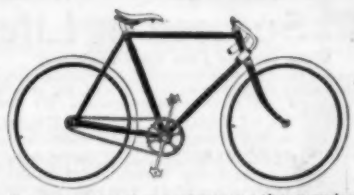

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